

**TECHNICAL IMPRACTICABILITY ZONE DELINEATION
WORK PLAN**

**SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS**

Prepared for:

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Carnegie, Pennsylvania 15106

MAY 2013

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1.0 INTRODUCTION

This document was prepared on behalf of Beazer East, Inc. (Beazer) and presents a Work Plan to collect additional and current data to support the Technical Impracticability (TI) Zone delineation of the horizontal and vertical extent of constituents of interest (COI) in the shallow and intermediate groundwater-bearing zones at the South Cavalcade Superfund Site located in Houston Texas (Figure 1). At a meeting among representatives of Beazer, U.S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) at EPA Region VI offices in Dallas, Texas on April 9, 2013. EPA informed Beazer that Region VI and EPA Headquarters personnel have determined that an amendment to the Record of Decision (ROD) for the Site, which incorporates a TI (TI) Waiver for groundwater remedial goals is appropriate. EPA stated that current data regarding the nature and extent of COIs in groundwater are needed to support the definition of the boundaries of the TI Zones. Beazer has agreed to conduct the site characterization activities to acquire current data to support the definition of the TI Zones.

The scope of the investigation proposed herein was developed through collaborative efforts of representatives of Beazer, EPA and TCEQ. The development of the scope of the investigation was initiated during the aforementioned April 9, 2013 meeting and was finalized during two subsequent conference calls among the parties on April 10, 2013 and April 19, 2013. During the April 19, 2013 conference call, EPA requested that Beazer prepare a brief Work Plan describing the scope of the investigation and the methodologies to be utilized for its implementation. This Work Plan was prepared in response to the EPA request. The specific objectives of the planned activities are outlined in the following subsection.

1.1 PROJECT OBJECTIVES

The primary purpose of the proposed investigation is to provide additional and current data to support the definition of the limits of the TI Zones. The data acquired through implementation of this Work Plan will also be used in support of the preparation of the Proposed Plan and ROD Amendment, and in the development of a proposed future groundwater monitoring program. The approach to attaining the stated objectives involve the development of a comprehensive “snapshot” of the current nature and extent of COIs in groundwater. The snapshot of current conditions will be obtained through the installation and sampling of several temporary monitoring wells, located predominantly along inferred preliminary TI Zone boundaries, concurrent with the sampling of existing monitoring wells and piezometers. This is the same investigation approach that was successfully employed for the 2005 Supplemental Groundwater Characterization effort which was designed to investigate the potential presence of preferential contaminant migration pathways at the Site.

A report of findings (Technical Impracticability Zone Delineation Report) will be prepared to document the results of the investigation. The report will include proposed TI Zone boundaries and a proposed future groundwater monitoring program.

2.0 TI ZONE DELINEATION SCOPE OF WORK

The following section presents the scope of work for the investigative activities and methodologies to be used for its implementation. Specific tasks to be conducted include the following:

- Existing Monitoring Well Search, Inspection and Gauging Activities
- Installation and Sampling of Temporary Monitoring Wells
- Existing Monitoring Well and Piezometer Sampling
- Quality Assurance/Quality Control

All work will be conducted in accordance with a project-specific Health and Safety Plan which is provided as Attachment A of this Work Plan. Details of the specific tasks are described in the following subsections.

2.1 EXISTING MONITORING WELL SEARCH, INSPECTION AND GAUGING ACTIVITIES

The well search, investigation and gauging activities will be conducted concurrent with the implementation of the potential TI Zone investigation as presented in Section 2.2. The results of these activities will be reviewed to determine whether any modifications to Section 2.2 and Section 2.3 are warranted, if any. For example, monitoring wells MW-08, OW-13, MW-24 and MW-25 could not be located during previous monitoring events. An additional attempt to locate these wells will be made as part of this task. If any of these wells are located, they will be inspected to determine whether they could produce representative groundwater samples. If it is determined that representative samples could be produced, then the monitoring wells will be sampled. In the case of wells OW-13 and MW-08, sampling of these wells could preclude the need for an adjacent proposed shallow temporary well. The well search, inspection and gauging activities will include the following:

- Locate all wells associated with the Site (on/off-site) and check the field location to those shown on existing Site maps;
- Check the wells to determine if their respective designations are clearly marked on the outer protective casing or on the inner well cap/casing, if a well is not clearly identified, then its designation will be marked on the outer protective casing;
- Inspect the condition of the well lock and replace if necessary;
- Identify the measurement reference point on the top of the monitoring well casing. If a reference point is not clearly identified, then one will be established by marking the top of the casing with a waterproof marker and a note will be made to have the newly established measuring point surveyed for location and elevation;
- Evaluate the condition of the locking protective well cover surrounding the monitoring well;
- Inspect the condition of the surface seal surrounding the monitoring wells protective cover;

- Identify the construction material and diameter of the inner well casing;
- Measure and record the depth to groundwater in the well;
- Check the well for the presence of DNAPL. If DNAPL is identified in the well, then the apparent thickness of the DNAPL layer will be measured and recorded;
- Measure and record the total depth of the well and compare to the original well depth to determine whether significant sediment has accumulated in the bottom of the well or if an obstruction exists; and,
- Record any other pertinent information (i.e., double-cased well).

2.2 INSTALLATION AND SAMPLING OF TEMPORARY MONITORING WELLS

This task includes the installation and sampling of a total of 33 temporary monitoring wells. The 33 temporary wells are comprised of 15 shallow and intermediate zone well clusters. The remaining three temporary wells are intermediate zone wells that will be paired with an existing shallow zone monitoring well. The temporary wells will be installed at 10 on-Site locations and 8 off-Site locations to the west or south of the Site. If constituents are detected at concentrations greater than applicable groundwater criteria, then additional temporary wells will be installed at locations further downgradient, as necessary, to define the TI Zones.

At each location, continuous soil sampling and logging will be performed. Lithologies will be described in detail and NAPL presence, along with a qualitative assessment of the degree of saturation (i.e., residual or free-phase) will be noted. Groundwater samples will be collected from each of the shallow and intermediate temporary monitoring wells. Figure 2 presents the proposed soil boring/temporary monitoring well locations. If a particular proposed location is not accessible to the drilling equipment, the boring will be relocated to the nearest accessible location.

Drilling and temporary well installation will be initiated at the downgradient off-site locations to the south and west of the Site. These temporary wells will be sampled as soon as practicable and expedited analytical turnaround times will be requested. Result of these analyses will be provided to EPA and TCEQ as soon as possible such that decisions can be made as to whether additional temporary wells and sampling are necessary to define the TI Zones.

2.2.1 Soil Borings and Temporary Well Construction

The soil borings will be advanced into the subsurface using direct push techniques (e.g., Geoprobe®). Before any subsurface work begins, underground utilities in the vicinity of the borings will be located by contacting the Texas One Call System. Boring locations may require adjustment based on the utility locations. The shallow zone borings will be advanced to the top of the clay unit, and are not expected to exceed a depth of 25 feet below ground surface (ft-bgs).

The intermediate zone borings will be advanced to the bottom of the intermediate zone and are not expected to exceed a depth of 60 ft-bgs. However, prior to advancement of the soil borings into the intermediate water bearing zone, an isolation casing (3-inch I.D. Steel) will be installed to prevent potential downward vertical migration from the shallow zone during sampling of the intermediate zone. The isolation casing will be set into the underlying clay unit below the

shallow water bearing sand unit. Prior to installation of the casing, pelletized bentonite will be placed into the base of the boring and hydrated to insure a competent seal at the base of the isolation casing.

A continuous soil core will be collected from all of the borings. The soil will be classified by the field geologist according to the Unified Soil Classification System (USCS). Photographs of the soil cores will be obtained as well. Soil descriptions will be recorded on the Soil Boring Log Field Form presented in Attachment B. Soil boring logs will include description of any potential water producing zones that are observed (i.e., thickness of coarser-grained seams), and any evidence of NAPL presence. Documentation of NAPL presence will include descriptions of odor, color, and qualitative degree of saturation (i.e., residual or free phase). The degree of impact, if any, will be recorded on the boring logs on a depth-specific basis. A qualitative numeric scale will be used to document the degree of impact, as follows:

- 0 – No observed DNAPL, stains, or odors
- 1 – Odor and/or Photo-Ionization Detector (PID) measurements above background
- 2 – Non-natural staining (color) or sheen
- 3 – Residual DNAPL (e.g., droplets, globules) observed (color)
- 4 – Apparent free phase DNAPL present

Note that determination of the presence of DNAPL in the soil cores is best made via removal of a portion of the soil once the soil core is sliced open. Removal of soil that was directly in contact with the liner (along the entire length of the liner) will expose minimally disturbed soil (i.e., soil that has not been subjected to smearing along the liner wall).

A PID will be used to screen the soil core for volatile organic compounds (VOCs). Initially, each core will be scanned along its length with the PID to identify any potentially impacted intervals. Sections of the core will then be retained for head space analysis in approximately two-foot intervals including any potentially impacted intervals identified by the initial scan.

Following the completion of a boring, a temporary monitoring well (one-inch inside diameter PVC pipe) will be installed in each of the borings. The wells will be completed with a natural sand pack (i.e., the formation will be permitted to collapse around the well screen. Information from the Verification of the Groundwater Fate and Transport Evaluation Report (VGFTER) showed that the dissolved constituents of interest preferentially migrate in the lower portion of the shallow aquifer. As such, the screen interval for the shallow temporary wells will be five feet in length and will be set with its base at least six-inches below the interface between the sand unit and the underlying clay. For the intermediate temporary wells the screen interval will be at least 10 feet in length and will be set with its base at least six-inches below the interface between the intermediate sand unit and the underlying clay layer. Previous site investigations have shown that the sandy units within the intermediate zone are not continuous beneath the Site and off-site areas of interest, especially in the southern portion of the study area. Thus, if a boring is advanced to a depth of 60 ft-bgs, and no water producing sand units are present at a particular location, the absence of groundwater will be noted and no temporary well will be installed at that location. If the only sand zones observed in the intermediate zones are at shallower depths, then

either the length of the well screen may be increased or the depth of the well adjusted such that the screen interval intersects with the water producing zones.

Following the completion of each soil boring, all downhole equipment will be thoroughly cleaned by washing all surfaces with an Alconox[®] (or equivalent) solution and rinsing with potable water.

2.2.2 Groundwater Sample Collection and Analysis

Once a sufficient volume of water has entered the temporary well, micro-purging of the well using a low flow (peristaltic) pump will be attempted. If the well goes dry in response to purging, the well will be allowed to recover and the sample collected as soon practicable. Otherwise, the sample will be collected after the parameter stabilization criteria specified in the Standard Operating Procedure (Attachment C) have been attained or a minimum of three well volumes have been removed, whichever occurs first. Purge water will be discharged into a bucket or similar container and will be visually inspected for any indication of impact.

Shallow groundwater samples will be collected using a peristaltic pump and dedicated Teflon tubing. To minimize agitation and aeration of the samples, they will be obtained as follows: 1) crimping the tubing upstream of the pump; 2) removing the tubing from the pump body, and 3) draining the groundwater from the tubing directly into the sample vials.

Intermediate groundwater sampling will be collected using low flow/micro-purge methods, similarly as previously discussed for the shallow zone temporary wells. The depth to groundwater in the intermediate zone may preclude the use of a peristaltic pump for purging and/or sample collection. If this is the case, low flow bladder pumps or equivalent will be used for purging and groundwater sample collection.

Field parameters including temperature, pH, conductivity, turbidity, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured at the time of sample collection using a water quality instrument(s). These results will be recorded on field sample log sheets (Attachment B). Observations during both purging and sampling regarding evidence of the potential presence of DNAPL (e.g., sheens, phase separation, spots, globules, color, etc.), if observed, will also be recorded on the sample log sheets.

Groundwater samples will be collected directly into pre-preserved, laboratory supplied containers, and placed immediately on ice. The samples will be shipped to the lab and analyzed for the following constituents:

- Target Compound List (TCL) Volatile Organic Compounds (VOCs);
- TCL Semi-Volatile Organic Compounds (SVOCs); and,
- Total and Dissolved Metals (arsenic, chromium, copper, lead, zinc).

The above analyte list includes all of the constituents with remedial goals specified in the ROD. Sample analyses will be performed using EPA Method 8260B (for VOCs), 8270C Low Level (for SVOCs), and 6020 (for Metals). The Method Detection Limits and Reporting Limits are

provided in Section 2.4 of the QAPP (Attachment D). Samples for dissolved metals analyses will be filtered in the field.

All reusable downhole equipment (i.e., pumps, cable, oil-water interface indicator) will be decontaminated between sample locations by washing all surfaces with an Alconox[®] (or equivalent) solution, followed by a deionized water rinse. All purge water and decontamination liquids will be containerized in 55 gallon steel drums, labeled, and staged on site in the area of the on-site water treatment facility.

2.2.3 Temporary Monitoring Well Abandonment

The temporary monitoring wells will be decommissioned in accordance with *Administrative Rules of the Texas Department of Licensing and Regulation 16 Texas Administrative Code, Chapter 76.104: Technical Requirements – Standards for Capping and Plugging of Wells and Plugging Wells that Penetrate Undesirable Water or Constituent Zones*.

The decommissioning procedure for the intermediate zone wells will be as follows:

- The well screen and riser will be removed from the borehole;
- The open borehole will be grouted up to the bottom of the temporary casing with a cement-bentonite mixture via a tremie pipe;
- The temporary casing will be removed and the open borehole will be grouted via a tremie pipe to the ground surface; and,
- Each location will be restored with cement to original grade.

Temporary shallow zone monitoring wells were decommissioned as follows:

- The well screen and riser will be completely removed from the borehole;
- The boreholes will be sealed to the ground surface with a cement-bentonite grout via a tremie pipe; and,
- Each location will be restored with cement to original grade.

2.2.4 Survey

Each location will be surveyed by a professional surveyor licensed in the State of Texas to determine horizontal location and elevation in reference to the Texas Coordinate System, South Central Zone, and the 1973 United States Coastal and Geodetic Survey adjustment of the 1929 mean sea level datum, respectively.

2.3 EXISTING MONITORING WELL AND PIEZOMETER SAMPLING

Groundwater samples will be collected from twenty-three monitoring wells and piezometers at the Site to supplement the data acquired from the 33 temporary wells. Figure 3 shows the well and piezometer locations to be sampled. The wells/piezometers to be sampled include the following:

Shallow Zone – Northern Area

PZN-20	OW-07
PZN-30	OW-09
PZN-40	OW-08
PZN-50	OW-14
MW-01	OW-02
MW-03	P-02N

Monitoring wells MW-24, MW-25 and OW-13 could not be located during the most recent groundwater sampling event. An additional attempt will be made to locate these wells during the search gauging and inspection task. If any of these wells are located and found to be capable of providing representative groundwater samples, then samples will be collected for analyses from the well(s). If OW-13 is located and deemed suitable for sampling, then the shallow temporary well at the adjacent location (DP13N-06S) will not need to be installed.

Shallow Zone – Southern Area

MW-04	PZS-30
MW-07	PZS-40
MW-26	PZS-60

Monitoring well MW-08 could not be located during the most recent groundwater sampling event. An additional attempt will be made to locate this well during the search gauging and inspection task. If this well is located and found to be capable of providing a representative groundwater sample, then a sample will be collected for analyses from the well.

Intermediate Zone – Northern Area

P-01	MW-12R
P-04	OW-15 or OW-16 (pending pre-sampling gauging and inspection)
MW-10	

Intermediate Zone – Southern Area

P-02R	MW-14R
P-03R	

Sample collection activities at each location will be recorded on the Groundwater Sample Collection Record (Attachment B). Prior to sample collection, depth to water, depth to DNAPL (if present), and total depth will be measured relative to an established measuring point with an oil-water interface indicator. Groundwater samples will not be collected from monitor wells or piezometers where DNAPL is detected.

Groundwater purging and sampling will be conducted in accordance with the Standard Operating Procedure included as Attachment C. The groundwater sample will be collected in pre-preserved, laboratory-supplied containers and immediately placed on ice. The samples will be shipped to the lab and analyzed for TCL VOCs, TCL SVOCs, and metals (arsenic, chromium, copper, lead, zinc). Sample analyses will be performed using EPA Method 8260B (for VOCs), 8270C Low Level (for SVOCs), and 6020 (for Total and Dissolved Metals). Samples for dissolved metals analyses will be filtered in the field.

All reusable downhole equipment (i.e., pumps, cable, oil-water interface indicator) will be decontaminated between sample locations by washing all surfaces with an Alconox® (or equivalent) solution, followed by a deionized water rinse. All purge water and decontamination liquids will be containerized for off-site disposal.

2.4 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control (QA/QC) for the project is discussed in detail in the Quality Assurance Project Plan (QAPP) provided as Attachment D. A brief summary of planned field QA/QC sampling, a general discussion of sample handling and custody, and an overview of the data usability assessment is provided in this section.

It is anticipated that a total at least of 59 groundwater samples will be collected as part of the TI Zone Delineation Investigation. As a result, the following QA/QC samples will be collected: three blind duplicates, three equipment blanks, three field blanks and three Matrix Spike/Matrix Spike Duplicates. In addition, one trip blank will accompany each cooler containing groundwater samples for VOC analyses.

All samples will be cooled to a temperature of 4 degrees Celsius and will be delivered to the laboratory in a timely manner such that the applicable method holding times for analysis are not exceeded. Chain of Custody (COC) documentation will be completed by the field sampling team leader and will accompany the sample shipment to the laboratory.

To ensure the utility of the sample results, a data usability assessment of the analytical data will be completed. This review will be completed by the project QA/QC Officer. The analytical results generated via SW-846 Method 8260B, 8270C, and 6020 will be reviewed in accordance with specific critical components of relevant U.S. EPA guidance for data validation. Specifically, analytical results will be reviewed considering the following general rubrics:

- Sample holding time compliance
- Acceptable surrogate spike recoveries
- Equipment, field and trip blank contamination
- Laboratory method blank artifacts
- MS/MSD RPDs and recoveries
- Field duplicate RPDs

The analytical results will be reviewed to ensure that samples were analyzed within an acceptable time frame (based on the date of sample collection). Surrogate recoveries will be

reviewed to determine if the Gas Chromatography/Mass Spectrometry instrumentation was performing adequately. Equipment, field and trip blank results will be reviewed to determine potential extraneous sources of sample contamination. Method blank results will be reviewed to identify the possibility of laboratory contamination of the samples. The MS/MSD results will provide an indication of the precision of the analytical method given the potential for matrix interference effects. The field duplicates will be used to document the precision of the sampling process.

The data usability assessment will be completed in accordance with applicable sections of the following guidance documents: U.S. EPA's Contract Laboratory Program, National Functional Guidelines for Organic Data Review and National Functional Guidelines for Inorganic Data Review. As required, this guidance document will be used in conjunction with the laboratory SOPs for the respective analytical methods. Professional judgment will be exercised throughout the data assessment effort, particularly for situations that are not addressed or clearly specified in the SOPs or in the guidance documents.

3.0 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) may include soil cuttings, purged groundwater, decontamination fluids, disposable sampling materials, and personal protective equipment (PPE). All IDW will be contained in labeled, steel 55-gallon drums and temporarily staged at the Site within the fenced area surrounding the groundwater treatment plant. One representative composite soil sample and one water sample will be collected and analyzed to characterize the materials for disposal. Once characterized, the IDW will be properly disposed of off-Site at a disposal facility approved by EPA and in accordance with applicable state and federal regulations.

4.0 SCHEDULE AND DELIVERABLES

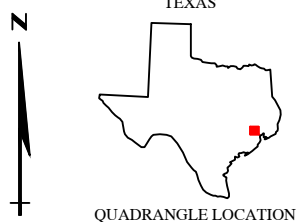
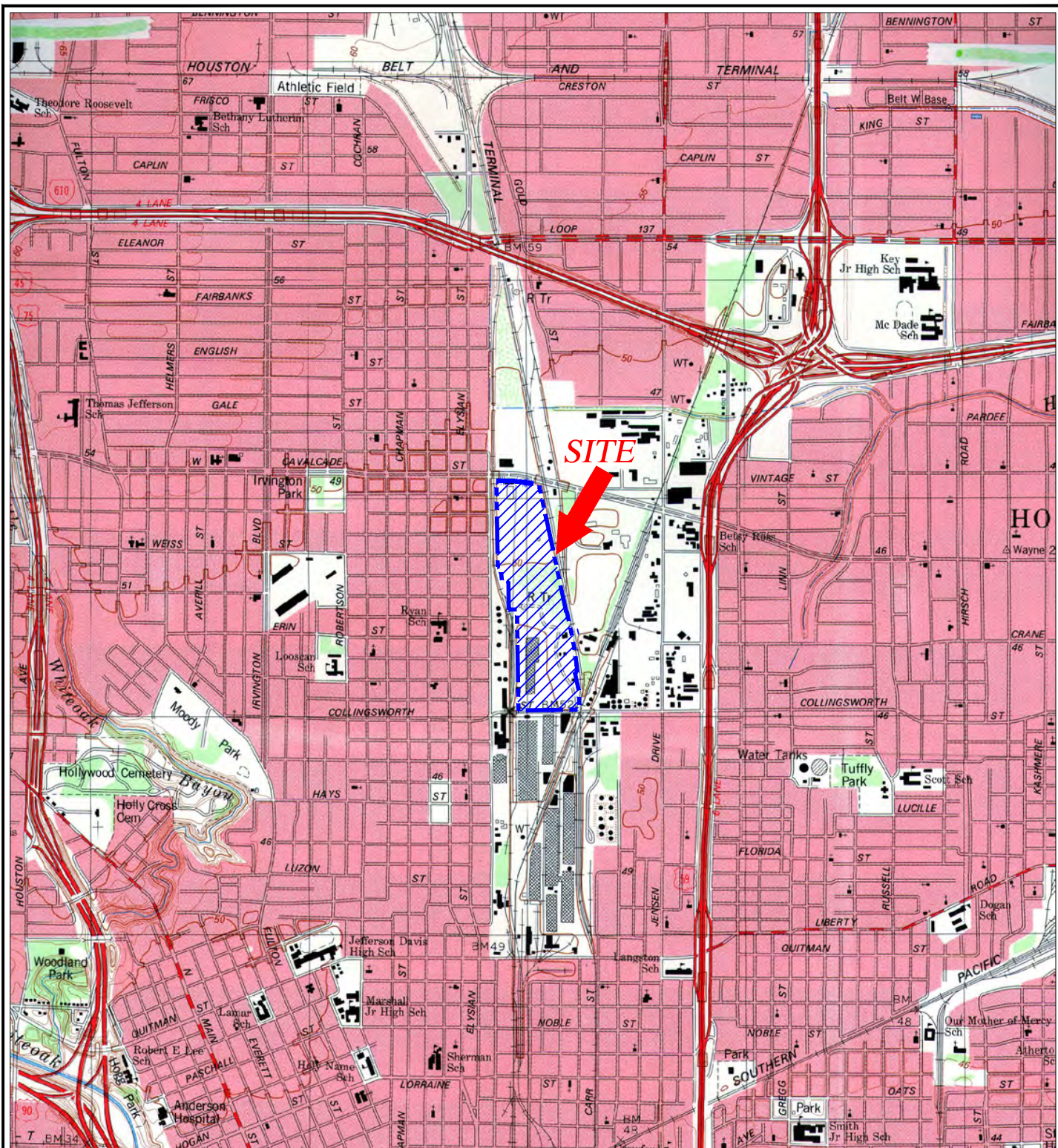
The work will be sequenced and multiple tasks conducted concurrently where feasible to expedite project completion to the extent practicable. Where necessary, an expedited analytical turnaround time will be requested from the laboratory. Drilling and temporary well installation will be initiated at the downgradient off-site locations to the south and west of the Site. These temporary wells will be sampled as soon as practicable and expedited analytical turnaround times will be requested. Result of these analyses will be provided to EPA and TCEQ as soon as possible such that decisions can be made as to whether additional temporary wells and sampling are necessary to define the TI Zone.

Pending approval to proceed and access to off-site properties, the field activities can be completed in four weeks. Analyses of the groundwater samples will be completed in one week following completion of field activities. As discussed at the April 9, 2013 meeting, Beazer, EPA and TCEQ will meet upon completion of the field activities, sample analysis, and data compilation to review and evaluate the results. It is planned that preliminary data evaluation, compilation and submittal to EPA and TCEQ will be completed within one week of receipt of the analytical data and that the meeting will occur less than one week following the data submittal. It is anticipated that the scope of the report of findings and schedule for submittal will be finalized during the meeting and that locations for proposed permanent monitoring wells can also be discussed. For preliminary scheduling purposes, it is anticipated at this time that a final report will be submitted within four weeks of the data review meeting.

A proposed project schedule is provided in graphical form as Figure 4. The duration of major activities is displayed and relevant milestones (e.g., mobilization and meeting dates) are depicted on Figure 4. Note that the schedule, as proposed, is based on the assumption that adverse weather conditions will not be encountered during the field effort and that installation of additional temporary wells at step out locations will not be required.

FIGURES

y:\south_cavalcade\13-665\technical impracticability zone delineation\workplan\figure 1.dwg Last Saved By: Scorer 4/29/2013 8:04 AM Plotted By: Shelly Comer 4/29/2013 8:56 AM Scale: 1:10168



QUADRANGLE LOCATION

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
OF SETTEGAST, TEXAS - 1982

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

BEAZER EAST, INC
PITTSBURGH, PENNSYLVANIA

DRWN: SCC DATE: 04/17/13
CHKD: JMV DATE: 04/17/13
APPD: JSZ DATE: 04/17/13
SCALE: 1" = 2000'

KEY ENVIRONMENTAL
INCORPORATED

TECHNICAL IMPRACTICABILITY ZONE DELINEATION WORK PLAN
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

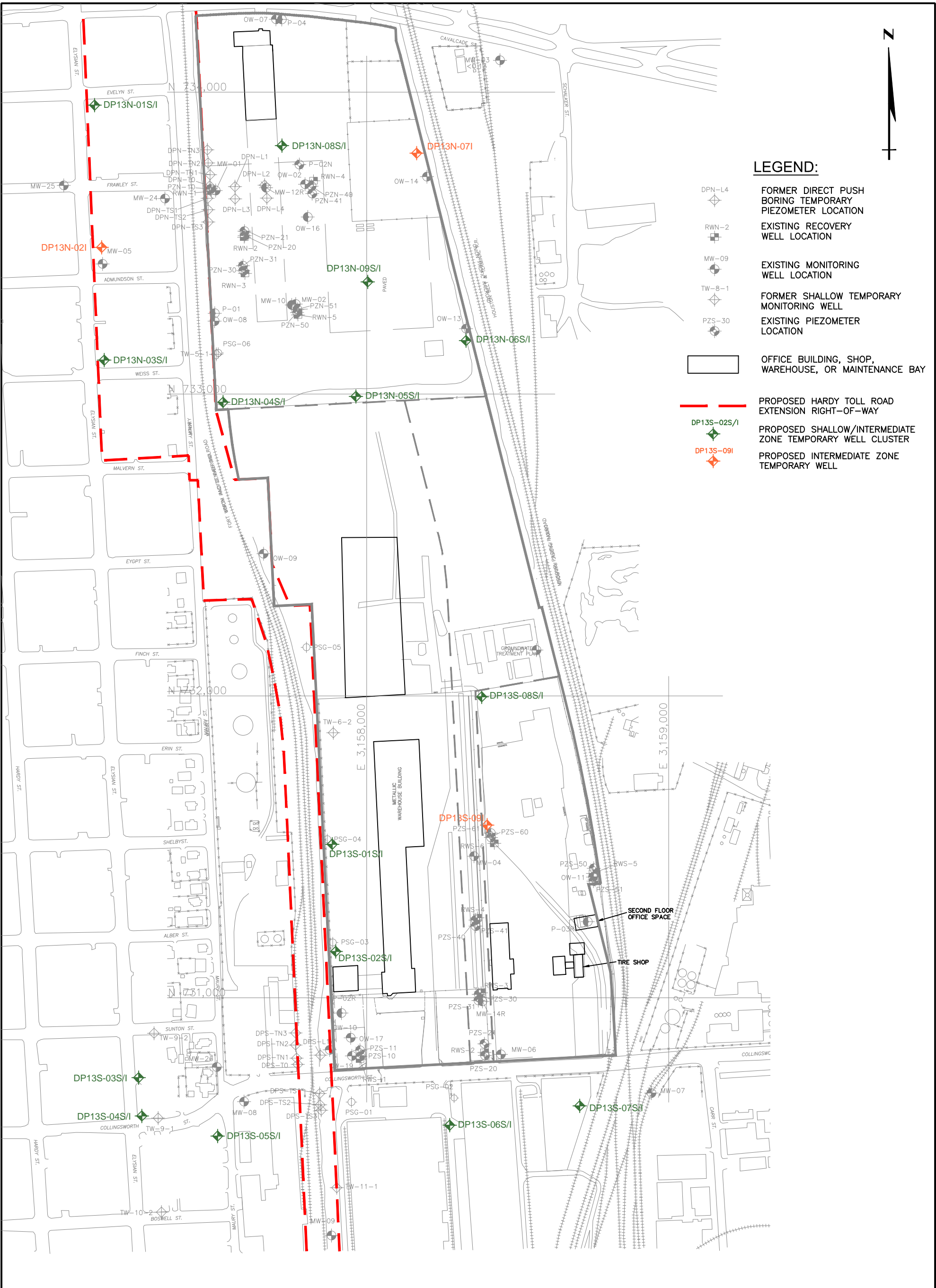
SITE LOCATION MAP

PROJECT NO: 13-665

FIGURE 1

006845

y:\south_cavalcade\13-665\technical impracticability zone delineation workplan\figure 2 proposed soil boring location.dwg shelley corner 1:1 4/29/2013 8:57 AM



BEAZER EAST, INC.
PITTSBURGH, PENNSYLVANIA

DRWN: SCC	DATE: 04/17/13
CHKD: JMW	DATE: 04/17/13
APPD: JSZ	DATE: 04/17/13
SCALE: AS SHOWN	

KEY ENVIRONMENTAL
INCORPORATED

TECHNICAL IMPRACTICABILITY ZONE DELINEATION WORK PLAN
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

PROPOSED TEMPORARY MONITORING WELL LOCATIONS	PROJECT NO: 13-665 FIGURE 2
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REV #	DATE	DESCRIPTION	APPD

REFERENCE:	ISSUE DATE:

KEY ENVIRONMENTAL, INC. 200 THIRD AVENUE CARNEGIE, PA 15106

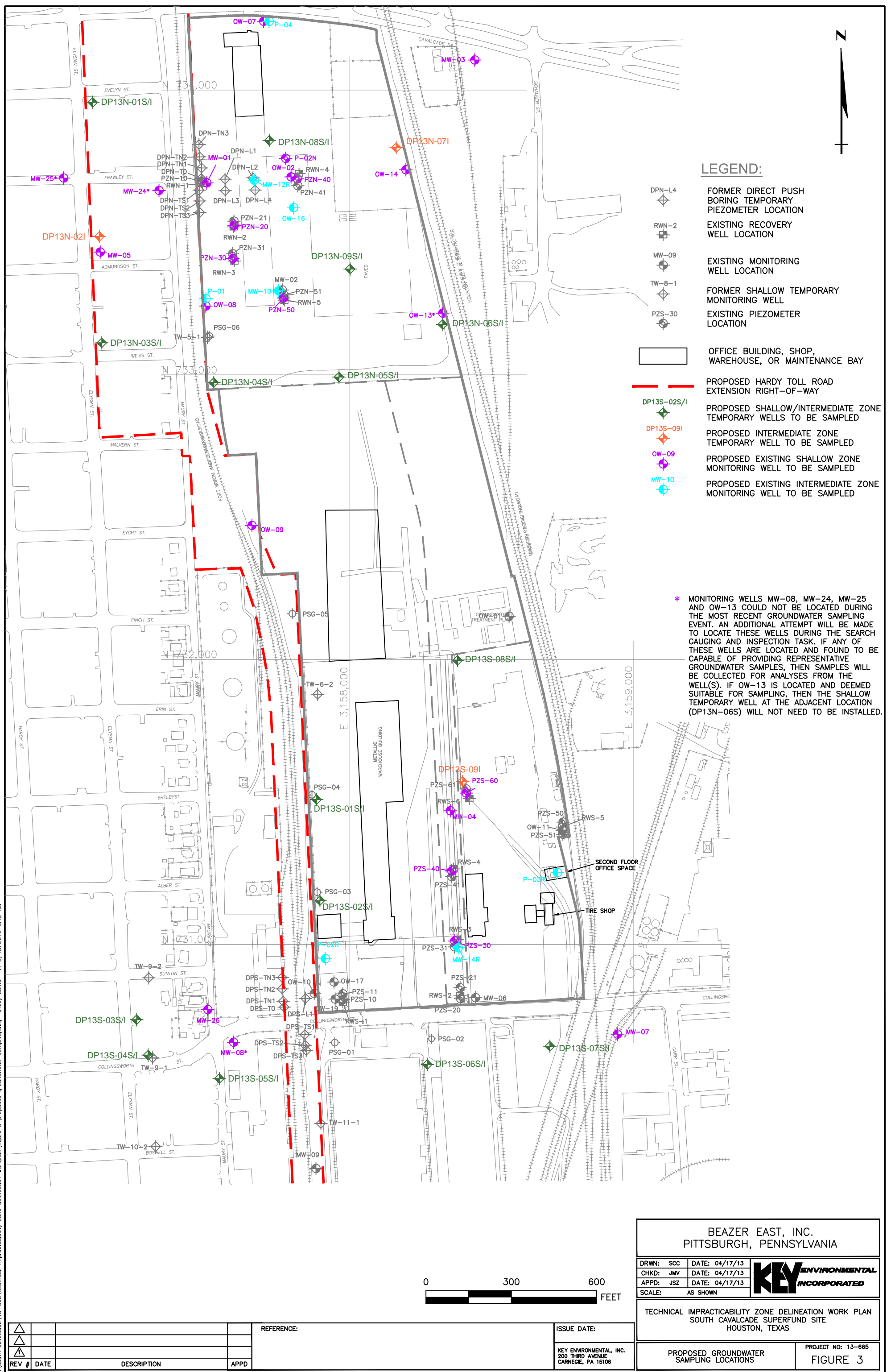
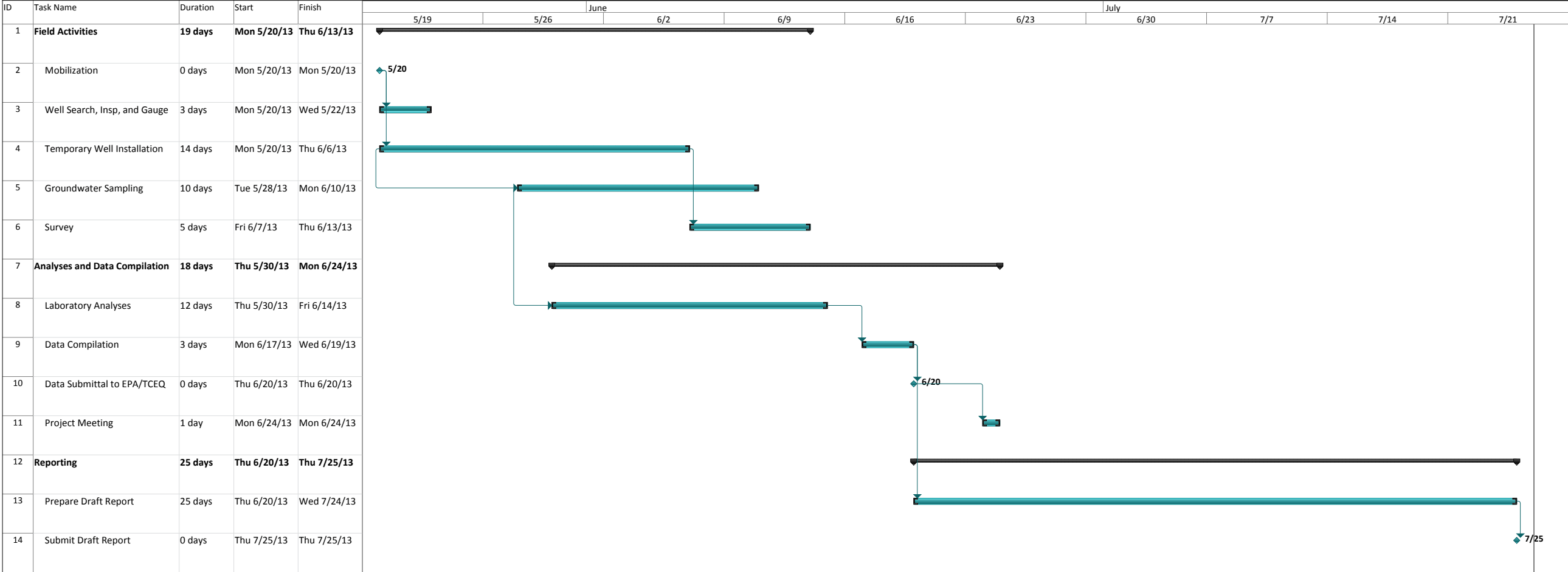


FIGURE 4
PROJECT SCHEDULE
TI ZONE DELINEATION
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS



Temporary Well installation will be initiated at the downgradient off-site locations. These wells will be sampled as soon as practicable and analyzed with an expedited turnaround. Data will be provided to EPA and TCEQ

Project: Cavalcade TI Zone Inv Date: Tue 4/30/13	Task	<div></div>	Summary	<div></div>	External Milestone	<div></div>	Inactive Summary	<div></div>	Manual Summary Rollup	<div></div>	Finish-only	<div></div>
	Split	<div></div>	Project Summary	<div></div>	Inactive Task	<div></div>	Manual Task	<div></div>	Manual Summary	<div></div>	Deadline	<div></div>
	Milestone	<div></div>	External Tasks	<div></div>	Inactive Milestone	<div></div>	Duration-only	<div></div>	Start-only	<div></div>	Progress	<div></div>

ATTACHMENT A
HEALTH AND SAFETY PLAN

**HEALTH AND SAFETY PLAN
TECHNICAL IMPRACTICABILITY ZONE DELINEATION**

**SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS**

Prepared for:

Beazer East, Inc.

Prepared by:

**Key Environmental, Inc.
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Carnegie, Pennsylvania 15106**

MAY 2013

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) describes Site specific procedures to be implemented by KEY Environmental, Inc. (KEY) employees and sub-contractors when performing additional delineation work activities at the South Cavalcade Superfund Site in Houston, Texas. All work must be performed in accordance with applicable federal, state, and local regulations, including, but not limited to:

U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) - 29 Code of Federal Regulations (CFR) 1910.120, "Hazardous Waste Operations and Emergency Response"; and,

OSHA - 29 CFR 1926, "Safety and Health Regulations for Construction."

The health and safety practices, procedures, and personal protective equipment (PPE) requirements established within this HASP are based on hazards known to be present at this Site. All protective measures employed must be commensurate with known hazards associated with specific work activities and job tasks and must be modified if other hazards are identified during the course of the work.

This HASP should not be used for activities other than those outlined in the scope of work unless a task-specific hazard and exposure assessment is performed and any additional protective measures incorporated into the HASP. This HASP is intended for use by KEY and may not include all subcontractor activities. Contractors or subcontractors performing activities not included in this HASP must prepare their own HASP in accordance with OSHA 29 CFR 1910.120.

2.0 PROGRAM ORGANIZATION AND RESPONSIBILITIES

Certain activities covered by this HASP will be performed by subcontractors working under the direction of KEY while some activities covered by this HASP will be performed by one or two persons from KEY. The following details the safety organization and responsibilities for both scenarios.

2.1 WORK PERFORMED BY KEY PERSONNEL

KEY On-Site Personnel are responsible for:

- Their own safety;
- Ensuring that they have the proper PPE and other necessary safety equipment;
- Ensuring that their training and medical surveillance is up-to-date;
- Becoming familiar with and complying with the HASP;
- Attending training sessions to review the HASP and other safety/health information;
- Being alert to previously identified and new hazards;
- Reporting unidentified hazards to the KEY Health and Safety Manager; and
- Conducting themselves in a manner that is orderly and appropriate for the Site.

KEY Project Manager

The Project Manager is responsible for ensuring that all activities are conducted in accordance with the HASP. The Project Manager has the authority to suspend field activities if employees are in danger of injury or exposure to harmful agents. The Project Manager's responsibilities include:

- Coordinating the development of a Site-specific HASP for all phases of the project;
- Ensuring that the appropriate health and safety equipment and PPE are available for project personnel;
- Ensuring that all personnel have received the appropriate training before they engage in activities that are potentially hazardous;
- Ensuring that all required personnel have received the required medical examination, testing, and screening before engaging in work activities; and,
- Designating a Site Health and Safety Officer (SHSO) and other Site personnel who will ensure compliance with the HASP.

2.2 SUBCONTRACTOR ACTIVITIES

Environmental investigative and delineation activities will include the use of subcontractors. In addition to being responsible for their own safety as outlined above, the on-site KEY personnel are also responsible for:

- Ensuring that KEY personnel, subcontractor personnel, and visitors comply with the requirements of this HASP; and,
- Notifying the KEY Project Manager or KEY Health and Safety Manager of any changes in work conditions or tasks which may require changes to the HASP.
- Acting as the Site Health and Safety Officer for field activities, whose duties include:
 - Coordinating safety meetings and daily safety briefings, as necessary;
 - Acting as the Emergency Coordinator at the Site and arrange for emergency response in cooperation with local emergency and health officials;
 - Monitoring conditions during field activities to assure compliance with HASP;
 - Monitoring conditions during field activities to determine if more stringent procedures or a higher level of PPE should be implemented;
 - Maintaining a log to record conditions, personnel involved in field activities, and other pertinent health and safety data;
 - Overseeing the arrangement and execution of personnel and equipment decontamination;
 - Suspending field activities if necessary, and resume activities when appropriate, and;
 - Controlling visitor, subcontractor, and employee access to hazardous areas.

Subcontractors are responsible for:

- Becoming familiar with the HASP;
- Complying with the contents of the HASP;
- Implementing their own HASP, or work procedures not covered in this HASP, as necessary and applicable;
- Attending training sessions to review the HASP and other safety/health information;
- Being alert to previously identified and new hazards;
- Reporting unidentified hazards to the KEY SHSO; and,
- Conducting themselves in a manner that is orderly and appropriate for the Site.

3.0 SITE CHARACTERIZATION AND HAZARD ASSESSMENT

3.1 SITE DESCRIPTION AND BACKGROUND

The South Cavalcade Superfund Site occupies approximately sixty-six acres of urban land approximately three miles north of downtown Houston, Texas. The site is rectangular in shape with a length of approximately 3,400 feet in the north-south direction, and a width of approximately 900 feet in the east-west direction. A site location map is provided as **Figure 1** and a site plan is provided as **Figure 2**.

The Site was operated as a wood treating plant from 1910 until 1962 using creosote and various metal salts in the wood treating process. The wood treating process area was located in the southern portion of the Site, along Collingsworth Street. Koppers Company, Inc. (Koppers), now known as Beazer East, Inc. (Beazer), operated the wood treating facility from 1944 until closure in 1962. A coal tar distillation plant was operated by Koppers on the southeastern portion of the Site from about 1944 until 1962. Much of the ground surface, especially in the southern and northern areas of the Site, is covered by concrete or asphalt pavement, or buildings. The central part of the Site is undeveloped. Land use in the vicinity of the Site is a mixture of commercial, industrial, and residential. The nearest residences are located several hundred feet to the west of the Site.

Groundwater monitoring wells and extraction wells have been installed at the Site as a result of previous investigations and the remedial action designated for the Site. A groundwater treatment facility is located along the eastern Site boundary in the central portion of the Site. Dense Non-Aqueous Phase Liquid (DNAPL) is recovered through the extraction wells.

Current activities involve additional delineation of the horizontal and vertical extent of constituents of interest (COI) in the shallow and intermediate groundwater-bearing zones at the South Cavalcade Superfund Site.

3.2 SCOPE OF WORK

The scope of work includes:

- Existing Monitoring Well Search, Inspection and Gauging Activities
 - Locate all on-site and off-site wells associated with the Site;
 - Check wells for identification, condition, construction, and any other pertinent information; and,
 - Measure and record depth readings and DNAPL (if any).
- Installation and Sampling of Temporary Monitoring Wells
 - Install and sample 33 temporary monitoring wells comprised of 15 shallow and intermediate well clusters;
 - Using direct push techniques (Geoprobe[®]);
 - 10 on-site locations, 8 off-site locations;
 - Measure depth of wells, water, DNAPL;

- Continuous soil sampling and logging, screen with PID; and,
 - Collection of groundwater samples (purging and sampling with low flow pumps, measure field parameters);
 - Temporary monitoring well abandonment - remove well screen and riser, grout borehole with bentonite, restore to grade with concrete; and,
 - Survey each temporary well location.
- Existing Monitoring Well and Piezometer Sampling
 - Measure well depths;
 - Groundwater purging and sampling;
- Equipment decontamination
- Handling investigation derived waste (IDW)
 - Containerize soil cuttings, purge water, and decontamination liquids into 55 gallon steel drums;
 - Stage investigative-derived waste (IDW) temporarily on-site and collect a soil sample and a water sample for analysis prior to disposal.

The work will be performed outside the source area where there is less potential for exposure to potential Site constituents.

3.3 CHEMICAL HEALTH HAZARDS

Potential chemical health hazards at the Site include the potential exposure to creosote/coal tar constituents including polynuclear aromatic hydrocarbons (PAHs), including naphthalene; and to the volatile organic compounds (VOCs) benzene, toluene, ethylbenzene, and xylene (BTEX). The Groundwater Fate and Transport Evaluation Report found the following upper range concentrations of potential constituents¹:

Constituent	Soil (mg/kg)	Groundwater (ug/l)
Benzene	---	780
Toluene	---	340
Ethylbenzene	---	940
Xylenes	---	1,000
PAHs Total	8,597	87,290
Naphthalene	---	43,000
Arsenic	---	522
Chromium	---	450
Copper	---	1,340
Lead	---	233
Zinc	---	1.180

1 Key Environmental, Inc. Groundwater Fate and Transport Evaluation Report for the South Cavalcade Superfund Site, August 1987.

The most likely routes of exposure to Site chemicals are through direct contact with soils and groundwater, and more likely, through direct contact with DNAPL when measuring DNAPL in wells. Concentrations of VOCs are low so there is only a very low potential for exposure to these compounds during work activities. The potential for overexposure to metals is very low because of the low concentrations in groundwater.

3.3.1 PAHs

The main route of exposure for creosote compounds, including PAHs, is skin/eye contact and absorption; a secondary route of exposure is inhalation of dust and vapors. The PAHs found on the Site pose only a slight inhalation hazard because they are not very volatile, that is, they are unlikely to vaporize. However, PAHs can cause skin and eye irritation upon contact and can cause systemic poisoning upon prolonged contact, inhalation, or ingestion. Some PAHs can cause cancer after prolonged exposure. However, prolonged overexposure to PAHs is not expected due to the short duration of anticipated project work. OSHA has not established exposure limits for most individual PAHs. Coal tar pitch volatiles is a category that contains several compounds, most of which are PAHs, so coal tar pitch volatiles is used as a surrogate measure for PAHs.

Immediate or acute effects from short-term exposure to coal tar compounds include irritation; burning, itching, redness, skin color changes, and rashes from skin contact with coal tar compounds. Photosensitization, a tendency to sunburn more easily or a worsening of rash with exposure to sunlight, may occur with skin contact to coal tar compounds. Inhalation of coal tar compounds, or dust which contains coal tar compounds, may irritate the respiratory tract. Eye contact may cause eye irritation, burning and inflammation. Ingestion may result in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress and shock. Absorption into the body systems by any route may cause trouble breathing, dizziness, headache, continuous or drawn out pulse, nausea, vomiting, salivation, and convulsions. Chronic or long-term effects of overexposure to coal tar compounds may cause dermatitis, and cancer of the skin, kidneys, and respiratory tract.

Exposure to potential Site constituents can be avoided or limited by the use of gloves and skin protection. For these reasons, potential exposure risks to PAHs are considered to be reasonably low.

3.3.2 VOCs

Benzene, ethylbenzene, toluene, and xylene may pose an inhalation hazard as well as a skin and eye hazard. However, the low concentrations of VOCs in ground water and soil represent a low risk of overexposure to these compounds. Acute or immediate effects of overexposure to VOCs include eye, nose, and respiratory tract irritation, headache, dizziness, drowsiness, shortness of breath, intoxication, nausea, vomiting, abdominal pain, and dermatitis. Severe overexposure may lead to unconsciousness and convulsions, coma, and death. Other signs of overexposure may include heartbeat irregularities, bronchitis, pulmonary edema, muscle spasms, incoordination, and confusion. Effects of frequent or long-term overexposure include headache, nervousness, lack of hunger, pale skin, rash, and sleeplessness. Chronic inhalation may result in lung, liver, and kidney damage. Long-term overexposure to benzene can cause blood disorders, such as leukemia and aplastic anemia. Benzene is a suspected human carcinogen.

Table 1 presents exposure limits and other properties of chemicals that may be present at this Site. More information concerning the health effects of Site chemicals can be found in the Material Safety Data Sheets (MSDS) in Appendix A. The MSDS for coal tar creosote is representative of information concerning PAHs.

3.3.3 Metals

Metals in groundwater may include arsenic, chromium, copper, lead, and zinc. Some of these metals can cause skin, eye and or respiratory tract irritation when in dry form but would pose no problem at the low concentration found in groundwater. Acute overexposure to some of these metals may cause headache, dry throat, chest tightness, nausea, and chills. Long term overexposure to some metals may cause metal fume fever with chills, fatigue, and coughing.

Arsenic is a skin, mucous membrane and eye irritant. Inhalation of dust containing arsenic may cause irritation of the nose and mouth and cause hoarseness. Long term overexposure may damage the liver, nervous system and blood forming system. Chromium may be present as the metal or as a chromic acid/chromate form. The chromic acid/chromate form can cause skin, eye and respiratory tract irritation. Long term overexposure can cause kidney damage. Inhalation of lead can cause appetite loss, nausea, muscle weakness and other symptoms. Long term overexposure to lead can cause kidney and reproductive system damage.

The potential for exposure to metals during delineation activities is very low because of the low concentrations of metals in groundwater and the low potential for direct skin contact with groundwater. The risk of overexposure to metals at the Site also is low because little dust is expected to be generated by field activities and field activities will be conducted over a short period of time.

3.3.4 Work Task Chemical Hazard Assessment

The overall chemical health hazard assessment for this Site is low. Potential exposure to Site constituents will be reduced or eliminated by following the work practices and using the personal protective equipment (PPE) designated in this HASP. Table 2 indicates the chemical hazards associated with Site work tasks, relative hazard assessment, proposed initial levels of personal protection, and air monitoring requirements.

3.4 PHYSICAL HAZARDS

The primary physical hazards on the Site are those associated with well installation activities. Physical hazards during well installation, groundwater sampling and DNAPL measurements and sampling may include muscle strain, lacerations, struck by and against, and slip, trip and fall. Safe work practices for these potential hazards are outlined in Section 5.0.

3.5 CONFINED SPACES

No confined space entry (CSE) is anticipated for work covered by this HASP. However, if a situation arises that requires entering a confined space then KEY Environmental and OSHA CSE

procedures must be followed, including atmospheric testing of the space and completion of a CSE permit before entry. A minimum of two trained employees must be present for any entry.

3.6 HEAT STRESS

A general physical hazard associated with outdoor work during warm weather is heat stress. There are three heat disorders that are of particular concern - heat cramps, heat exhaustion, and heat stroke. *Heat cramps* occur due to the depletion of body salts from sweating. *Heat exhaustion* results from significant loss of body salts and fluid. Its symptoms may include weakness or fatigue, nausea, headaches, and in more serious cases, clammy, moist skin with pale or flushed complexion. *Heat stroke* is the most serious and occurs when the body's system to regulate internal temperature fails. Symptoms of heat stroke are hot, dry skin; mental confusion or delirium; convulsions or unconsciousness; and body temperature of 105°F or higher. In this situation, medical attention is needed immediately; heat stroke may be fatal.

To prevent heat disorders, attention must be paid to such variables as temperature, humidity, air movement, and the physical condition of employees. In addition, breaks must be taken as needed to let the body cool. Liquids designed to replace lost body salts must be provided regularly.

3.6.1 Heat Stress Prevention

Heat stress can occur even when temperatures are considered moderate, such as in spring or fall. The following recommendations should be followed to help reduce heat stress:

- Personnel must drink plenty of liquids to replace body fluids lost to sweating. To prevent dehydration personnel should be encouraged to drink generous amounts of water even if not thirsty. Heat-related problems can happen before the sensation of thirst occurs.
- Cool drinking water, 50°F to 60°F, should be made available to all personnel.
- Only water, or occasionally, electrolyte-balanced drinks, such as Gatorade®, should be used to replace lost fluids due to sweating.
- Beverages containing caffeine, such as colas, coffee, or tea, should be limited or not used because of their diuretic (water depleting) effects.
- Salt tablets should not be used unless prescribed by a physician.
- Self-monitoring of physical condition and buddy monitoring will be essential in order to prevent any heat stress illness. All personnel should be aware of heat stress symptoms and the proper precautions to take if heat stress is observed.
- Rest periods must be provided for all personnel. This means at least 15 minutes in the morning and in the afternoon and at least 30 minutes for lunch. A more frequent rest

schedule may be implemented by the SHSO depending on weather conditions and the type of work performed.

3.7 OUTDOOR HAZARDS

Biological hazards present at the Site may include poisonous plants, insects, and animals. Poison ivy and/or poison oak may be present. Contact with the leaves, vine, roots, or sap of poison ivy or poison oak causes a skin rash on many people. All workers must be familiar with the appearance of poison ivy (three leaves) and wear impervious protective clothing as necessary to prevent contact with poison ivy. Poison ivy/oak can still cause a reaction even in cold weather because the sap is still in the plant.

Ticks may be present throughout the Site on brush, grass, and weeds. Some ticks carry disease, such as Lyme disease or Rocky Mountain spotted fever. Wear protective clothing or secure pant legs to lower leg or boot and apply bug repellent to this area as noted below for mosquitoes. Frequently assist each other in inspecting for ticks. If a tick is found attached to the skin, do not attempt to pick the tick off the skin with fingernails or scrape with a credit card, etc. Carefully remove the tick with tweezers taking care that all parts are removed. Thoroughly scrub the area with soap and water. Save the tick in a small jar or plastic bag and take it to a doctor or health department for identification. If a red circle or rash forms in the area of the tick bite or if flu-like symptoms appear in a few days or weeks consult a doctor for treatment.

A particular hazard at this Site during warmer weather is mosquitoes. Besides the annoyance of the buzzing insects and ordinary mosquito bites, some mosquitoes can transmit West Nile Virus and other diseases. West Nile Virus can be a serious disease, especially for people over 50 years old. Most people have no symptoms after infection but some people have mild symptoms that can include fever, headache, body aches, nausea, vomiting, and swollen lymph glands or a skin rash on the chest, stomach and back. Symptoms last a few days to several weeks. A few people develop severe illness. Symptoms may include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. Symptoms may last several weeks and neurological effects may be permanent. People older than 50 are at a higher risk to get sick. A very few people may die from a West Nile virus infection.

The best way to prevent West Nile Virus is to avoid being bitten by mosquitoes. When working outdoors wear light-colored long sleeve shirts, long pants and socks sprayed with insect repellent. Use repellent carefully! Follow the manufacturer's directions for the repellent you are using. Repellents with DEET (N, N-diethyl-meta-toluamide) or permethrin are effective against mosquitoes and other biting insects. You can use DEET directly on your skin and clothing but do not use on skin under clothing. Use permethrin only on clothing, not directly on skin, and let sprayed clothing dry before use. Repellents with a higher concentration do not mean they work better but that they work longer.

Sweating or getting wet may mean you need to re-apply repellent more frequently. If possible wash exposed skin before re-applying repellent. Be sure to wash skin that was sprayed with repellent at the end of the day. Wash hands before eating or using the restroom.

Wasps, bees and other stinging insects may also be found at the Site. Use of DEET or repellent containing permethrin will help keep wasps and bees away. However, if a nest is disturbed the repellent will not help. Be alert for bees flying into and out of a particular area, hanging nests, and nests in logs, pipes and other structures. Wear light-colored clothes as darker clothes tend to annoy some stinging insects.

First aid for insect bites and stings includes: applying a baking soda paste or ice wrapped in a wet cloth. Commercial bee sting kits may be helpful. Honeybees leave their stingers in the body; these can be removed by gently scraping the skin, working side to side of the stinger. A bee sting or snake suction device can also be used. If an insect bite becomes red or inflamed or the person becomes dizzy, nauseous, or short of breath then get to medical care immediately.

Poisonous red ants or fire ants also may be found at the Site. These ants usually build mounds in open sunny areas and near rotting logs, around tree stumps, and sometimes near buildings. They are attracted to electrical fields and may sometimes be found around electrical housings and installations and also around well pipes. Fire ant stings are painful and the venom leaves a white pustule. Symptoms of a fire ant sting include burning and itching as well as the white pustule which may take a day or two to form. Fire ants can sting repeatedly and will attack anything that disturbs their nest. Although stings are not usually life threatening, multiple stings may lead to secondary infections.

The best protection in areas of heavy fire ant infestation is to wear boots with pant legs tucked in or taped to boots so ants cannot crawl up under pant legs. In areas of where ants are less concentrated continual vigilance is needed to ensure that ants do not crawl onto personnel. If stung treat the area with an insect bite remedy that deadens pain and protects against infection. Get medical help in case of multiple stings; or if a person reacts severely to stings.

Avoid unnecessary contact with animals. Some animals may carry disease or poison or may cause injury by biting. If an animal is acting strangely, or if a wild animal approaches humans, leave the area. If necessary, call animal control personnel. Do not try to feed wild animals.

Snakes may also be present on the Site. Leave snakes alone, do not attempt to catch or kill. Stay out of tall grass, brush, and wood or rock piles. Keep hands and feet out of areas you cannot see. If bitten, get the person to medical help immediately. If practical, try to quickly identify the type of snake or at least the color and markings and size. First aid for snake bites includes: Wash the bite with soap and water or antiseptic cleanser, immobilize the bitten area and keep it lower than the heart, cover the area with a clean, cool compress or a moist dressing to minimize pain and swelling. Keep the victim calm and comfortable. If the victim cannot reach medical care within 30 minutes apply a bandage, wrapped 2 to 4 inches above the bite, to help slow the venom. This should not cut off the flow of blood from a vein or artery – the band should be loose enough to slip a finger under it. Without cutting, place a suction device over the bite to help draw venom out of the wound. Continue alternating suction and application of a compress while transporting to a doctor or hospital. Do not give the victim food or alcohol and only limited other liquids as necessary.

4.0 MEDICAL SURVEILLANCE

4.1 PRE-ASSIGNMENT SCREENING

KEY employees who work at this Site must have a current medical screening and approvals for Site work in accordance with 29 CFR 1910.120 (f) and KEY medical screening policies and procedures. This screening includes:

- Medical history;
- Occupational history;
- Physical examination;
- Determination of fitness to work wearing protective equipment and respirators;
- Baseline laboratory studies; and,
- Medical evaluation to determine employee's ability to wear a respirator (for employees who may wear a respirator).

Employees engaged in work with potential exposure to hazardous materials must undergo a periodic update of medical and occupational history and a periodic physical examination equivalent to the pre-assignment exam. Medical examinations must also be made available to any employee that has developed, or believed he has developed, signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or if the employee has been injured or exposed above the permissible exposure limit (PEL) or published exposure levels in an emergency situation.

4.2 SUBCONTRACTORS

Subcontractors performing work under this HASP are required to have medical training as above. In general, subcontractors who will perform work at this Site where there is a potential for contact with Site constituents are required to follow the medical surveillance requirements of 29 CFR 1910.120 and a medical surveillance program. Subcontractors who perform work where there is no potential for exposure to Site constituents, are not required to follow the medical surveillance requirements of 29 CFR 1910.120.

5.0 WORK PRACTICES AND SITE CONTROL

5.1 SAFE WORK PRACTICES

5.1.1 Routine Safe Work Practices

Proper personal hygiene and the buddy system are integral parts of safe work practices and must be followed by all KEY employees while working at the Site:

- Site activities that involve serious hazards should be performed by a work team of at least two people. Site personnel may use judgment and be flexible in defining when two persons must be present.
- Hygienic practices consistent with work hazards are necessary. Eating and food preparation will be prohibited in any area other than those designated and properly protected. No food or tobacco products will be permitted in work areas. Beverages are only permitted as noted in Section 5.1.8. Employees who handle potentially contaminated materials or articles will wash with soap or mild detergent and water before eating or using the rest room.

5.1.2 Work Restrictions

All outdoor work at the Site must be conducted during daylight hours unless adequate lighting is provided. Outdoor work must cease immediately upon the signs of impending thunderstorms and lightning or other severe weather, as determined by the SHSO.

5.1.3 Underground and Overhead Utilities

Underground utilities and pipelines can present special hazards such as electrocution, sudden release of pressure (gas or liquid), and explosion and fire. Check with Facility personnel and contact local utilities before drilling or other subsurface work and/or call the Houston One-Call Center at 1-800-669-8344. Check for any overhead wires before work. Keep equipment at least 20 feet away from overhead lines.

5.1.4 Geoprobe®

Personnel working on or near the Geoprobe® must be aware of the hazards of the equipment and follow the manufacturer's use recommendations. Particular hazards include pinch points when raising/lowering and other movement of the probe, pinch points when "hammering", and hot hydraulic fluid in the hoses. Unauthorized personnel must not attempt to operate the Geoprobe®. Hearing protection should be worn when operating or working near the Geoprobe®.

5.1.5 Opening Wells

Opening wells may release vapors of potentially hazardous site constituents, which have concentrated in the headspace of wells. Precautions to prevent exposure include:

- Open wells carefully and allow to vent before taking measurements or sampling;
- Stand to the side and avert face when opening wells.

5.1.6 Gauging and Sampling Wells

These activities increase the potential for exposure to Site constituents that can cause eye, skin and respiratory tract irritation, burns and photosensitization. Care must be taken to wear long sleeves, nitrile gloves, and safety glasses, especially when manually bailing, to limit exposure from DNAPL on the rope and bailer. Attempt to bail in a manner that limits the whipping of rope during the process. A Tyvek suit or apron may be needed if there is a potential for getting DNAPL on oneself during sampling, measuring, or when deconning the measuring tape.

5.1.7 Noise

Employees working on or near noisy equipment must wear hearing protection if the 8-hour time-weighted average noise level exceeds 85 decibels. A general field rule is that hearing protection must be used if normal speech cannot be understood within an arms length of the person talking.

5.1.8 Use of Drinking Water or Liquids

All carrying containers and cup dispensers must be closed and covered to protect against dust and vapors.

- Only disposable cups may be used to dispense and drink liquids.
- Use a cup dispenser so that one cup may be easily removed at a time and no other cups are touched.
- Cups may not be reused. (One use may be several consecutive refills. Do not set a cup down and reuse that same cup during the next break.)
- Remove or clean soiled gloves before using a cup.
- Thoroughly clean and decontaminate the drink container and cup dispenser before refilling and before taking them off-Site.

5.1.9 Slip, Trip, Fall

Hazards found at the Site and areas where groundwater sampling occurs may include uneven terrain, holes, ditches, unstable slopes, slippery surfaces, unmarked projections, and ground debris that can cause employees to trip and fall. Take care to notice and avoid unsafe site conditions.

- Visually examine the walking area;
- Test your footing;

- Make sure the walking/work area is adequately lit;
- Be aware of ground debris; remove broken glass, nails, wire, and other debris if possible, or mark off and avoid areas of heavy debris.

5.1.10 Working in the Street

Some locations of wells are located in or adjacent to streets near the Site. Potential hazards include personnel and vehicle accidents. Follow these precautions when working near or in the street:

- Contact Houston public works or police department to ascertain the proper procedures for working near or in the street.
- If needed, hire an off-duty police officer to direct traffic during work activities.
- Wear reflective vests at all times when working near or in the roadway.
- Place traffic cones 25-50 feet ahead of and behind the work area.
- Place traffic cones or around the immediate work area.
- Place traffic safety barricades ahead of and behind the work area.
- Park vehicles off the street or parallel to and ahead/behind the work area.
- Be careful when entering and leaving vehicles – watch for oncoming traffic and wait to open doors.

5.2 SITE ACCESS/SITE CONTROL

Reduce or eliminate the possibility of exposure or transfer of contaminated substances through the following methods, as appropriate for the work task(s):

- Set up barriers to exclude personnel from contaminated areas;
- Minimize the number of personnel and equipment at the Site;
- Establish work zones within the Site;
- Establish control points with regular access to and egress from work zones;
- Conduct operations in a manner to reduce exposure of personnel and equipment; and,
- Implement appropriate decontamination procedures.

5.2.1 Site Access

The Site is enclosed by fencing. Access for authorized personnel is through a locked gate on Cavalcade Street. The SHSO will be responsible for security around the exclusion/work zones.

5.2.2 Work Zones

Exclusion zones for well installation should be established approximately 20-25 feet around the Geoprobe[®]. Once the well is installed and the rig moves to a different area that particular EZ ceases to exist. Unauthorized personnel may be kept out of these areas with signs or verbal warnings.

Specific work zones are not necessary for tasks where there is little chance of overexposure to Site constituents to others. These tasks include ground water and soil sampling.

At least partial decontamination of personnel and equipment should occur at work areas when appropriate. A separate, common decontamination area(s) should be set up to allow for personnel decontamination as well as equipment decontamination after work is complete for each day. The SHSO must determine the appropriate Site zones upon arrival at the Site and before intrusive activities begin. The location of the Site work zones may change with the work and the type of activity performed.

5.3 SITE HOUSEKEEPING

The Site must be kept in a neat, organized, and orderly fashion. Items, such as tools, equipment, hoses, *etc.*, must be kept picked up to minimize tripping and falling hazards. Used disposable clothing and equipment must be placed in drums or plastic bags immediately upon removal and the drum lids replaced or bags closed.

5.4 SANITATION/CHANGING FACILITIES

Appropriate sanitation must be used on-Site, including, but not limited to, the following:

- Maintaining an adequate supply of potable water.
- Access to nearby sanitary facilities, including adequate toilets and wash facilities.

5.5 CONSTITUENT(S) AND EXPOSURE PREVENTION

Exposure to hazardous or contaminated materials must be kept to a minimum by adherence to the recommended PPE and decontamination procedures. All Site personnel must avoid potential exposure to Site constituents when possible, e.g., do not handle potentially contaminated materials without proper PPE, do not stand downwind during excavation or other subsurface activities, etc.

5.6 BUDDY SYSTEM

Personnel must adhere to the buddy system when conducting field activities, meaning that they must work in groups of at least two when wearing PPE or when working in an exclusion zone.

5.7 SITE COMMUNICATIONS

- Verbal and Hand Signals - will be the main types of Site communication.
- Telephones - Cell phones may be used for off-Site communication, if necessary.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 SITE-SPECIFIC LEVELS OF PROTECTION

The level of protection for most Site activities will be Level D or a modified Level D. Level D will consist of:

- Long or short sleeve shirts (as appropriate for the season) and long pants.
- Appropriate gloves for material handling activities
- Steel-toe and shank safety boots
- Hard hat.
- Safety glasses with side shields.
- Hearing protection as required.

Level D plus nitrile gloves may be used for most, if not all, Site activities where the only contact with potential site constituents is handling soil/sediment samples or ground water during sampling.

A Modified Level D may be needed for activities that increase the chance for skin exposure to DNAPL. Modified Level D may consist of Level D as above plus the following as appropriate for the activity:

Modified Level D will consist of Level D as above plus:

- A regular Tyvek or polycoated Tyvek suit or apron to avoid body/clothes contact;
- Nitrile inner gloves;
- Nitrile outer gloves as necessary; and,
- Nitrile Rubber or chemically resistant overboots.

6.2 UPGRADE CONDITIONS

If conditions should change where there is a possibility of overexposure to vapors or dust then vapor/dust suppression techniques used, or employees should work upwind to reduce potential exposures. If these measures do not reduce vapor and/or dust concentrations below the acceptable limits set forth in Section 7.0, then contact the KEY Health and Safety Manager for information on how to proceed.

Level C or Level B protection is not expected to be necessary during Site activities. The SHSO has the responsibility for monitoring Site and work task conditions and deciding the appropriate level of protection based on the air monitoring guidelines presented in Section 7.0 and any other indications of potential exposure.

7.0 MONITORING

7.1 REAL-TIME MONITORING

Monitoring for organic vapors must be conducted prior to and during all intrusive Site activities (soil boring and well installation). A Photoionization Detector (PID) with a 10.2 /10.6 electron volt (eV) bulb must be used to conduct air monitoring for organic vapors. Periodic air monitoring should be conducted in the work zone and in the breathing zone of workers. Readings should be recorded prior to and during initial subsurface activities, whenever there is a reading above background, and at least once per hour during work activities. Readings may be recorded on the Real-Time Monitoring Log (Appendix B) or in the field logbook.

Air monitoring is not required as part of groundwater sampling or depth measurements, or for DNAPL thickness measurements.

For any work activity, a sustained (greater than 5 minutes) organic vapor level in the breathing zone above the concentrations in the following table will require vapor suppression techniques or working upwind of the source. If these methods are not feasible or do not reduce the potential exposure below acceptable levels, then employees must upgrade to Level C protection.

AIR MONITORING ACTION LEVELS			
Constituent	Concentration	Location	Response
Total Organic Vapors	1 to 10 ppm	Breathing Zone in Work Area	Continue PID for 5 to 15 minutes. If reading still exceeds 1 ppm use vapor suppression or work upwind.
Total Organic Vapors	10 to 50 ppm	Breathing Zone in Work Area	Stop work and call the KEY Health & Safety Manager.
Total Organic Vapors	>50 ppm	Breathing Zone in Work Area	Evacuate area until vapors dissipate. Monitor from a distance. Contact the Project Manager for instructions before proceeding.

7.2 INSTRUMENT CALIBRATION

Monitoring equipment must be calibrated and checked for proper operation daily before the start-up of any field activities requiring monitoring. Before initiating field activities, background measurements should be obtained with each instrument upwind and away from potential Site influences. Instrument calibrations and background levels must be documented on daily air monitoring logs or in a field log. A Rae Systems PID with a 10.2 eV or 10.6 eV lamp, or equivalent monitor, will be used to monitor for organic vapors.

8.0 MATERIAL HANDLING AND DECONTAMINATION

All waste material, decontamination liquids, and decontamination equipment must be handled in a safe and healthful manner. Decontamination and material handling activities must be carried out within the appropriate work zone.

8.1 DECONTAMINATION

A personnel decontamination area must be provided where surface constituent(s) and outer protective equipment are removed. This area must be determined upon arrival at the Site and before any intrusive activities begin.

8.1.1 Personnel Decontamination

The general decontamination procedure is as follows.

Level D Decontamination:

- Equipment drop onto plastic drop cloth.
- Wash and rinse boot covers and gloves if to be reused.
- Remove and dispose of Tyvek suit in a plastic-lined container or plastic bag.
- Remove boot covers and gloves, dispose in plastic bag or lined containers if not to be reused. Place in "decontaminated PPE" container if to be used again.
- Field-wash hands and face.

There may be partial field decontamination before traveling from one work location to another. This may consist of removing or cleaning boots or boot covers and outer gloves after completing an activity and before moving to the next workstation. The SHSO must advise the field crew of any necessary field decontamination procedures. The SHSO is responsible for monitoring the effectiveness of decontamination procedures and modifying the procedures as necessary to ensure proper decontamination.

8.1.2 Equipment Decontamination

All equipment used in an exclusion zone must be decontaminated before it leaves the Site or is taken into a clean area. Small tools and equipment used in the EZ that become contaminated may be taken to the decontamination area taking care to isolate the tools/equipment from clean materials and equipment. Equipment may be decontaminated by washing with detergent and water then rinsing, or other appropriate decontamination methods. Vehicles that contact potentially contaminated soil or water must be decontaminated before leaving the Site by brushing clean and washing as necessary. Verification that equipment/vehicles leaving the Site have been adequately decontaminated is the responsibility of the SHSO.

8.1.3 Investigation-Derived Waste

Investigation derived waste (IDW) may include soil cuttings, purged groundwater, decontamination fluids, disposable sampling materials, and personal protective equipment (PPE). All IDW will be contained in labeled, steel 55-gallon drums and temporarily staged at the Site within the fenced area surrounding the groundwater treatment plant. One representative composite soil sample and one water sample will be collected and analyzed to characterize the materials for disposal. Once characterized, the IDW will be properly disposed of off-Site in accordance with applicable state and federal regulations.

9.0 EMERGENCY PROCEDURES

The HASP for this project has been established to allow project activities to be conducted without adverse impacts on worker health and safety. In addition, supplementary emergency response procedures have been developed to cover extraordinary conditions that might possibly occur at the Site. Emergency telephone numbers, directions to the nearest hospital, and a route map to the hospital are presented in Appendix D. Make sure you know your way to the hospital in an emergency.

Pre-emergency planning consists of the preparation of this emergency response plan, posting of the emergency contact list and hospital route map, assigning emergency functions to on-Site personnel, training of personnel as necessary, and ensuring that emergency procedures and equipment are in place.

The KEY Supervisor/SHSO is designated as the Site Emergency Coordinator for KEY's activities and is responsible for field implementation of this emergency response plan and has full authority for KEY personnel and subcontractors in the event of an emergency. If outside agencies respond to an emergency, the Site Emergency Coordinator will pass the responsibility and authority for emergency response to the Incident Commander for the outside agency as appropriate. The Site Emergency Coordinator will assist outside emergency response agencies as much as possible to control and resolve the emergency. In general, on-site personnel would immediately evacuate the area to the designated safe place of refuge. Communications consist of verbal and hand signals on-site and use of a portable telephone for off-site communication.

The Site Emergency Coordinator, or if the Site Emergency Coordinator is unavailable, the designated alternate on Site, will contact emergency personnel. In the event of severe injury to KEY personnel or subcontractors, KEY personnel may start first aid then contact outside personnel for assistance.

PPE and emergency equipment will be available on-Site for response to minor emergencies. PPE includes gloves, protective clothing, protective booties, and safety glasses. An emergency first aid kit will also be available on-site.

Evacuation routes, safe distances, and places of refuge will be determined before the start of work at the Site and the locations made known to all personnel who enter the Site. These may be modified at the start of each work day based on site specific or work task factors. The SHSO will maintain security around the immediate Site work zones. Because of the limited number of personnel expected to be working on the Site, the SHSO will know who is on Site and can control entry of personnel into hazardous areas in an emergency.

9.1 EMERGENCY MEDICAL TREATMENT AND FIRST AID

In the event of a safety or health emergency at the Site, appropriate emergency measures will immediately be taken to assist those who have been injured or exposed and to protect others from hazards. The project field personnel will take the injured party and transport (if possible) to the

nearest hospital for treatment, after determining whether personnel decontamination can be performed on the injured party.

If the injury to a worker is chemical in nature (e.g., overexposure), the following first-aid procedures will be instituted:

- Eye Exposure - If a solid or liquid gets into the eyes, wash the eyes immediately at the emergency eyewash station using large amounts of water and lifting the lower and upper lids occasionally to help flush the eye. Do not let the victim rub eyes or keep eyes tightly closed. Flush for at least 15 minutes. Obtain medical attention immediately.
- Skin Exposure - Promptly wash the area using mild soap and flooding amounts of water for at least 15 minutes while removing contaminated clothing and shoes. Consult a physician for reddened or blistered skin.
- Swallowing - Do not induce vomiting! Never give anything by mouth to an unconscious person. Call poison control center: Akron Regional Poison Center, (800) 362-9922.
- Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. Do not use mouth-to-mouth respiration. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and mask. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

First aid supplies must be immediately available at the site. Personnel performing work must have a first aid kit as part of their field supplies. First aid kits will consist of appropriate items for the work being performed and anticipated emergencies. In addition, a portable eyewash bottle and solution should be part of the first aid supplies taken to the Site.

Employees that will work at the Site are responsible for checking the contents of the first aid kit before the kit is sent to the job site to ensure that all required items are present and that expended items are replaced. This employee is also responsible for ensuring that the kit is readily accessible at the site. When more than one person is on site the most senior person has the responsibility for the contents of the kit.

9.2 EMERGENCY EVALUATION, INVESTIGATION AND DOCUMENTATION

The Site Emergency Coordinator will evaluate the available information about the incident and KEY's emergency response capabilities including what happened, any injuries or casualties, further accident potential, and what can be done to remedy the emergency. The type of response action will be based on the available information about the emergency incident.

The emergency incident will be investigated by KEY and all findings put in writing as soon as conditions return to normal. The KEY Supervisor/SHSO will ensure that documentation is as complete as possible by including a chronological history of the incident, facts about the incident and when they became available, titles and names of personnel and composition of teams, actions made, orders given, actions taken, samples and results, possible exposures, and a history of all

injuries or illness during or as a result of the emergency. After the situation has returned to normal, all aspects of the emergency incident and the response will be reviewed to assess procedures used, how to improve response, and how to prevent further emergencies.

10.0 TRAINING

10.1 GENERAL

All employees or other personnel entering the Site (other than the support zone) that are also involved in operations that could involve exposure to hazardous waste must receive training in compliance with OSHA 29 CFR 1910.120(e). The training requirements are intended to provide employees with the knowledge and skills necessary to perform hazardous waste site operations while minimizing the potential for injury. Initial training consists of a minimum of 40 hours of off-Site classroom and practical exercise training and 3 days of actual field experience. Training must be updated annually with 8 hours of off-Site training. Supervising personnel will complete an 8-hour training session for supervisors. Training must be certified by record and/or certificate.

10.2 SITE-SPECIFIC TRAINING

Site-specific training must consist of an initial health and safety briefing on the following information:

- Names of individuals responsible for Site health and safety and methods of communicating safety and health concerns;
- Site-specific health and safety hazards;
- Use of PPE;
- Work practices by which employees can minimize risk;
- Safe use of equipment on-Site;
- Recognition of symptoms and signs of exposure to hazardous materials;
- Site control measures;
- Decontamination procedures; and,
- Emergency response procedures.

The SHSO or Site supervisor should give the health and safety briefing prior to initiation of field activities. This briefing must be of sufficient duration to address all of the material covered in this HASP. All personnel that will be participating in field activities must have the opportunity to read this HASP prior to this initial meeting so that any questions they have can be addressed at the initial meeting.

10.3 SAFETY MEETINGS

Prior to commencing field activities each day, a short briefing may be conducted by the Site Supervisor to address the day's activities. The daily briefing also provides the opportunity for the SHSO to address any special health and safety issues and to notify individuals of any deficient areas that need to be corrected or operational changes made that affect field work. The briefing should emphasize the specific concerns associated with the day's planned field activities. Daily weather reports should be reviewed to determine work/rest regimens.

TABLES

TABLE 1
EXPOSURE LIMITS AND OTHER PROPERTIES
OF POTENTIAL SITE CONSTITUENTS
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Constituent	Exposure Limits ^[b]	STEL ^[c]	IDLH ^[d]	Vapor Pressure ^[e]	Ionization Potential ^[f]
Coal Tar Pitch Volatiles (PAHs) ^[a]	0.2 mg/m ³	---	80 mg/m ³	Varies	Varies
Naphthalene	10 ppm	15 ppm	250 ppm	0.08 mm	8.12 eV
Benzene	0.5 ppm	5 ppm	500 ppm	75 mm	9.24 eV
Ethylbenzene	100 ppm	125 ppm	800 ppm	7 mm	8.76 eV
Toluene	50 ppm	---	500 ppm	21 mm	8.82 eV
Xylene	100 ppm	150 ppm	900 ppm	9 mm	8.56 eV
Arsenic	0.01 mg/m ³	---	5 mg/m ³	0 mm	NA
Chromium III	0.5 mg/m ³	---	---	0 mm	NA
Copper	1 mg/m ³	---	---	0 mm	NA
Lead	0.05 mg/m ³	---	700 mg/m ³	0 mm	NA
Zinc (Zinc oxide)	2 mg/m ³	---	---	0 mm	NA

Constituent	Carcinogen ^[g]	Skin Exposure ^[h]	LEL/UEL ^[i]	Odor Threshold ^[j]	3M/NIOSH Respirator Selection ^[k]
Coal Tar Pitch Volatiles (PAHs)	YES	YES	---	---	R95 or P95
Naphthalene	YES	NO	0.9 - 5.9%	0.015 ppm	OV
Benzene	YES	NO	1.2 - 7.8%	8.65 ppm	OV
Ethylbenzene	NO	NO	0.8 - 6.7%	2.3 ppm	OV
Toluene	NO	YES	1.1 - 7.1%	0.16 ppm	OV
Xylene	NO	NO	1.0 - 7.0%	0.324 ppm	OV
Arsenic	YES	NO	NA	NA	N100
Chromium	No, only CrVI form	NO	NA	NA	N95
Copper	NO	NO	NA	NA	N95
Lead	NO	NO	NA	NA	N100
Zinc	NO	NO	NA	NA	N95

Notes:

- [a] OSHA has not established individual exposure limits for most PAHs. Coal Tar Pitch Volatiles is a category containing several compounds, most of which are classified as PAHs; so Coal Tar Pitch Volatiles can be used as a surrogate for PAHs.
- [b] Exposure Limit: 8-hour Time Weighted Average (TWA) from the Threshold Limit Values of the ACGIH, or OSHA Permissible Exposure Limit (PEL), whichever is lower.
- [c] STEL: Short Term Exposure Limit, denotes a 15 minute average that may not be exceeded.
- [d] IDLH: Immediately Dangerous to Life or Health - Maximum concentration from which one could escape within 30 minutes without a respirator and without experiencing any irreversible health effects.
- [e] Vapor Pressure: From NIOSH Pocket Guide to Chemical Hazards. Water = 0 mm. Above 1 mm is considered volatile; above 100 mm is considered highly volatile
- [f] Ionization Potential: Expressed in electron volts (eV) from NIOSH Pocket Guide to Chemical Hazards. Used to determine type of detector bulb for the PID.
- [g] Carcinogen: "Yes" indicates compound is a confirmed or suspected human carcinogen by NIOSH, OSHA or ACGIH.

- [h] Skin Exposure: "Yes" indicates potential significant exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact to ambient vapors.
- [I] LEL/UEL: Lower and upper explosive limits. Percent of material needed in air for ignition when exposed to an ignition source.
- [j] Odor Threshold: Air concentration at which most people can smell the chemical.
- [k] 3M/NIOSH Respirator Selection: Type of respirator recommended by the 3M Respirator Selection Guide or the NIOSH Pocket Guide to Chemical Hazards. SA = Supplied Air (Level B); OV = Organic Vapor Respirator (Level C); N, R, or P 95, 97, or 100 = Dust and mist respirator (Level C).

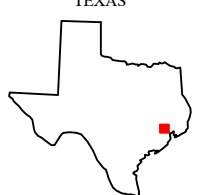
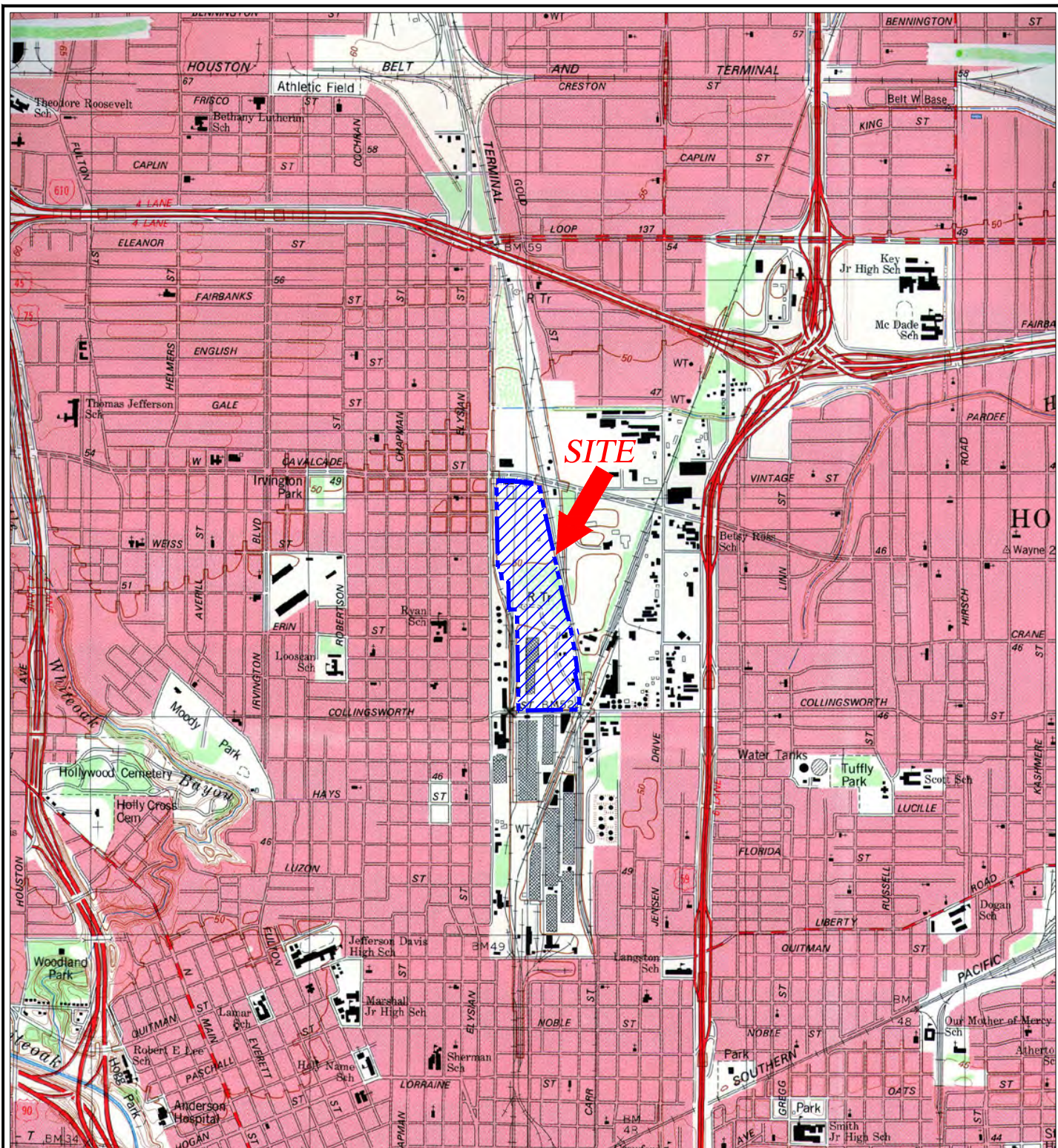
TABLE 2
TASK-SPECIFIC HAZARD ASSESSMENT WITH
PROPOSED INITIAL LEVELS OF PROTECTION
AND AIR MONITORING REQUIREMENTS
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Task	Chemical Hazard Assessment	Estimated Initial Level of Protection	Air Monitoring
			VOCs
<u>Existing Monitoring Well Search, Inspection and Gauging Activities:</u>			
Locate all on-site and off-site wells	Low	D	NO
Low	Low	D	NO
Measure and record depth readings and DNAPL (if any)	Low	D	NO
<u>Installation and Sampling of Temporary Monitoring Wells</u>			
Install 33 temporary monitoring wells comprised of 15 shallow and intermediate well clusters using direct push techniques (Geoprobe®)	Low	D	YES
Measure depth of wells, water, DNAPL	Low	D	YES
Continuous soil sampling and logging, screen with PID	Low	D	YES
Collection of groundwater samples (purging and sampling with low flow pumps, measure field parameters)	Low	D	YES
Temporary monitoring well abandonment - remove well screen and riser, grout borehole with bentonite, restore to grade with concrete	Low	D	NO
Survey each temporary well location	Low	D	NO
<u>Existing Monitoring Well and Piezometer Sampling</u>			
Measure depth of wells, water, DNAPL	Low	D	YES
Groundwater purging and sampling	Low	D	YES
Equipment decontamination	Low	D	NO
<u>Handling investigation derived waste (IDW)</u>			
Containerize soil cuttings, purge water, and decontamination liquids into 55 gallon steel drums	Low	D	NO
Stage investigative-derived waste (IDW) temporarily on-site and collect a soil sample and a water sample for analysis prior to disposal.	Low	D	NO

Note: Air monitoring with the PID is just checking the wells when they are opened before starting work or checking newly installed wells. Continuous monitoring is not required unless conditions change or an initial positive reading has been obtained.

FIGURES

y:\south_cavalcade\13-665\hsp\figure 1.dwg Last Saved By: Scorer 4/25/2013 3:13 PM Plotted By: Shelly Comer 4/29/2013 2:21 PM Scale: 1:1,0168



QUADRANGLE LOCATION

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
OF SETTEGAST, TEXAS - 1982

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

BEAZER EAST, INC
PITTSBURGH, PENNSYLVANIA

DRWN: SCC DATE: 04/23/13
CHKD: BLH DATE: 04/23/13
APPD: JSZ DATE: 04/23/13
SCALE: 1" = 2000'

KEY ENVIRONMENTAL
INCORPORATED

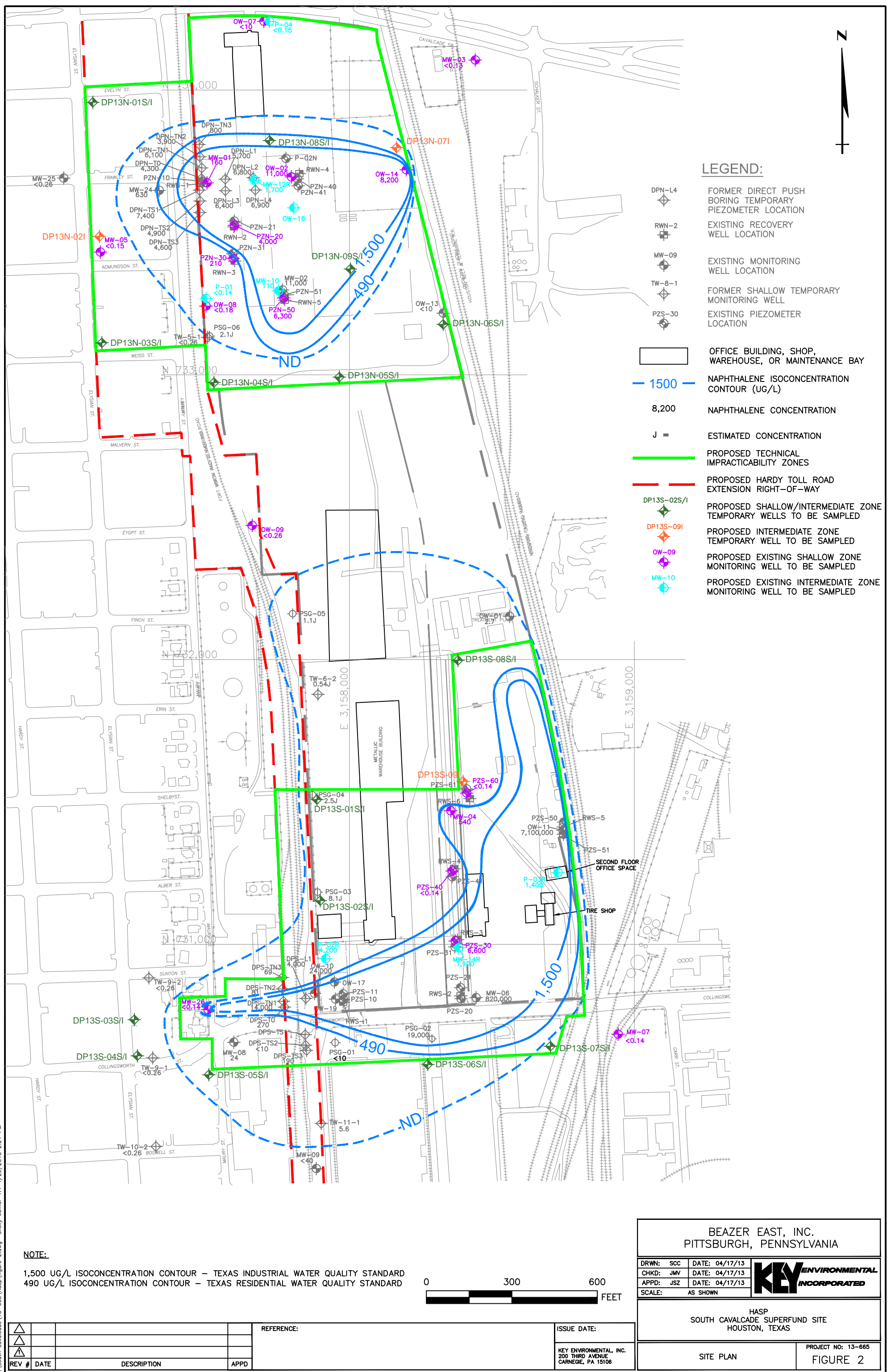
HASP
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

SITE LOCATION MAP

PROJECT NO: 13-665

FIGURE 1

006881



APPENDIX A

**LIST OF HAZARDOUS CHEMICALS
AND
MATERIAL SAFETY DATA SHEETS**

LIST OF HAZARDOUS CHEMICALS
South Cavalcade Superfund Site

Chemical	Container/Amount	Manufacturer /Distributor	Use
Potential Site Constituents:			
Coal Tar Creosote/PAHs	Soil/groundwater	NA	NA
Naphthalene	Soil/groundwater	NA	NA
Benzene	Soil/groundwater	NA	NA
Toluene	Soil/groundwater	NA	NA
Ethylbenzene	Soil/groundwater	NA	NA
Xylene	Soil/groundwater	NA	NA
Arsenic	Soil/groundwater	NA	NA
Chromium	Soil/groundwater	NA	NA
Copper	Soil/groundwater	NA	NA
Lead	Soil/groundwater	NA	NA
Zinc	Soil/groundwater	NA	NA
Chemicals that may be brought on site:			
Alconox liquid/solution			Clean sampling equipment
Acetone			Clean sampling equipment
Isopropyl Alcohol			Clean sampling equipment
Hexane			Clean sampling equipment
Nitric Acid	A few milliliters in sample jars		Sample preservative
Hydrochloric Acid	A few milliliters in sample jars		Sample preservative
Sulfuric Acid	A few milliliters in sample jars		Sample preservative
Zinc Acetate/Sodium Hydroxide Solution (two MSDSs)	A few milliliters in sample jars		Sample preservative
pH 10 Buffer Solution			Water testing
pH 4 Buffer Solution			Water testing
pH 7 Buffer Solution			Water testing
Conductivity Standard			Water testing
Bentonite (example MSDS)			Sealing Wells
Portland Cement (example MSDS)			Sealing Wells

The following Material Safety Data Sheets (MSDSs) are provided for general information on the chemical and physical properties and potential health hazards of constituents that may be present at the Site. The use of manufacturer names does not imply that these products were in fact used at the Site; nor imply or infer any liability on the part of the manufacturer of any product represented, or the preparer of the MSDS.

Material Safety Data Sheet
Coal Tar Distillate
(Recovered Material for Reuse/Recycling)
(Not a Manufactured Product)

Section 1 --- Material Identification

Trade Name: Recovered Coal Tar Distillate for Reuse/Recycling (*Not a manufactured product*)

Synonym: None

Provider: Beazer East, Inc.
One Oxford Centre
Pittsburgh, PA 15219

Emergency Telephone No.: (800) 424-9300

Section 2 --- Composition/Information on Ingredients

Coal tar distillate is a complex mixture of hydrocarbons.

<u>INGREDIENTS</u>	<u>CAS NO.</u>	<u>% by Wt.</u>	<u>OSHA PEL-TWA</u>	<u>ACGIH TLV-TWA</u>
Coal Tar Distillate ¹	65996-92-1	100	0.2 mg/m ³	0.2 mg/m ³
Indene	95-13-6	<10	10 ppm	10 ppm
Naphthalene	91-20-3	<15	10 ppm	10 ppm
Biphenyl	92-52-4	<5	0.2 ppm	0.2 ppm
Benzene	71-43-2	<1	1 ppm	0.5 ppm
Alkyl naphthalene	---	<10	None	None
Phenanthrene	85-01-8	9-13	None	None
Benz(a)anthracene	56-55-3	0.5-2	None	None
Benzo(a)phenanthrene	218-01-9	0.5-2	None	None
Benzo(b)fluoranthene	205-99-2	---	None	None
Benzo(k)fluoranthene	207-08-9	---	None	None
Benzo(j)fluoranthene	205-82-3	---	None	None
7,12-Dimethylbenz(a)anthracene	57-97-6	1-3	None	None
Indeno (1,2,3-cd) pyrene	193-39-5	0.1-0.3	None	None
Benzo(a)pyrene	50-32-8	0.5-2	None	None
Dibenz(a,h)anthracene	53-70-3	0.01-0.1	None	None
Benzo(g,h,i)perylene	191-24-2	---	None	None
7-H Dibenz(o,c,g)carbazole	194-59-2	0.01-0.2	None	None
Dibenzo(a,l)pyrene	191-30-0	0.01-0.1	None	None
1-Nitropyrene	5522-43-0	0.1-0.3	None	None
Dibenz(a,j)acridine	224-42-0	0.01-0.1	None	None
Dibenz(a,h)acridine	226-36-8	0.01-0.1	None	None

Notes:

1 The exposure limit for coal tar pitch volatiles is used as the overall exposure limit for this product.

Section 3 --- Hazard Identification

Emergency overview

CHRONIC OVEREXPOSURE (as defined by OSHA recommended standards) MAY CAUSE CANCER

WARNING

MAY BE FATAL IF SWALLOWED

HARMFUL TO THE SKIN OR IF INHALED

CAUSES EYE AND SKIN IRRITATION

AVOID PROLONGED OR REPEATED CONTACT

OBSERVE GOOD HYGIENE AND SAFETY PRACTICES WHEN HANDLING THIS PRODUCT

DO NOT USE THIS PRODUCT UNTIL MSDS & PRODUCT LABEL HAVE BEEN READ/UNDERSTOOD.

WARNING: THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

HMIS Rating: Health - 2, Fire - 1, Reactivity - 0

Potential health Effects

Primary Entry Routes: Inhalation of vapors or mist, eye/skin contact, incidental or inadvertent ingestion.

Target Organs: Respiratory tract, skin, eyes, bladder, kidneys.

Acute (Immediate) Effects

Inhalation: Acute overexposure to vapor may result in respiratory tract irritation. Repeated and/or prolonged contact to high concentrations of vapor may result in respiratory difficulties, central nervous system (CNS) effects characterized by headache, drowsiness, dizziness, weakness, incoordination, circulatory system collapse, coma, and possible death.

Eye: Direct contact with liquid or vapor may cause moderate to severe irritation and burns.

Skin: Skin contact can cause severe irritation, redness, burning, rash and itching which is made worse by exposure to sunlight (photosensitization).

Ingestion: Ingestion of the material may cause gastrointestinal disturbances including irritation, nausea, vomiting, and abdominal pain. Systemic effects are similar to those described under "Inhalation".

Chronic (Long Term Effects)

Effects of long term or repeated exposure to coal tar distillates may include dermatitis, skin cancer and lung cancer.

Carcinogenicity

This material or similar materials has caused cancer in laboratory animals when administered throughout the major part of their lifetime.

The IARC monographs (Vol. 35) lists creosotes from coal tars, coal tars, and coal tar pitch volatiles as Group 1 carcinogens (carcinogenic to humans). The NTP Eleventh Annual Report on Carcinogens lists coal tars and coal tar pitches as Known to be Human Carcinogens.

This product contains benzene. The IARC monographs (vol. 29) lists benzene as a Group 1 carcinogen (carcinogenic to humans). The NTP Eleventh Annual Report on Carcinogens lists benzene as a Known to be Human Carcinogen.

This product contains naphthalene. The IARC monographs (vol. 82) lists naphthalene as Group 2B carcinogen (possibly carcinogenic to humans). Naphthalene is also listed in the NTP Eleventh Annual Report on Carcinogens as Reasonably Anticipated to be a Human Carcinogen.

Section 4 --- First Aid Measures

Inhalation: Move the person to fresh air and support breathing as required. Consult a physician if victim has continued difficulty breathing.

Eye Contact: Lift eyelids and flush immediately with flooding amounts of water for at least 15 minutes. Do not allow the victim to rub his/her eyes or keep them shut. Consult a physician or ophthalmologist if all material cannot be removed or if there is continuing irritation.

Skin Contact: Remove clothing around affected area. Wipe away loose material and wash affected area with soap and water or waterless (non-alcohol) hand cleanser. If there is a severe skin reaction or reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center with information from this MSDS. Unless the poison control center advises otherwise, give the person one or two glasses of water or milk, then induce vomiting. After vomiting, the victim may be given a slurry of 100g. of activated charcoal in 8 oz. of water. Seek medical aid.

Section 5 --- Fire Fighting Measures

Flash Point: >93°C (>200°F)

Autoignition Temperature: Not determined.

Lower Explosive Limit: Not determined.

Upper Explosive Limit: Not determined.

Extinguishing Media: Use dry chemical, carbon dioxide, or foam. Use water spray only if the preferred measures are not available.

Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar distillate presents a vapor explosion hazard indoors, outdoors and in sewers. Material is not sensitive to contact or static discharge.

Hazardous Combustion Products: Oxides of carbon and other toxic vapors may be given off in a fire. Thick, black acrid smoke may be generated.

Fire Fighting: Wear a self-contained breathing apparatus (SCBA) with full facepiece operated in the pressure demand or positive pressure mode and full protective clothing. Do not allow runoff from fire fighting to enter roadways or sewers. Use water to cool off containers and structures and to protect personnel.

Section 6 --- Accidental Release Measures

Stop leak if there is no risk involved. Stay upwind of the spill or leak. Wear appropriate protective clothing and respiratory protection for the situation. If the material has solidified shovel into dry containers and cover. For wet spills use sand or noncombustible absorbent material. Collect spilled material and place in sealed containers for reclamation or disposal. Recycle or dispose of material according to local, state, and federal regulations. This product released into the environment must be reported to the National Response Center (1-800-424-8802). When this product is spilled or leaked the reportable quantity is 1 lb. or more).

Section 7 --- Handling and Storage

Handling: Avoid prolonged or repeated breathing of vapors, mists or fumes. Avoid prolonged or repeated contact with skin or eyes. Observe good personal hygiene practices and recommended procedures. Application of certain skin creams (sun screen in conjunction with a general purpose protective cream) before working/several times during work may be beneficial. Wash exposed areas promptly and thoroughly after skin contact from working with this product and before eating, drinking, using tobacco products or rest rooms.

Storage: Store in a closed, labeled container within a cool or well shaded and dry, ventilated area. Protect containers from physical damage. Keep containers closed when not in use. Maintain good housekeeping.

Section 8 --- Exposure Controls and Personal Protection

Engineering Control and Ventilation: Provide sufficient general/local exhaust ventilation in pattern/volume to control inhalation exposures below current exposure limits and areas below flammable vapor concentrations. Local exhaust is necessary for use in enclosed or confined spaces. See OSHA 29 CFR 1910.146 Permit Required Confined Space.

Respiratory Protection: Not required under normal use conditions. If ventilation does not maintain inhalation exposures below the PEL or TLV then wear NIOSH/MSHA approved respirators per the current OSHA respiratory protection standard, 29 CFR 1910.134 and the respirator manufacturer's instructions and warnings. Use NIOSH respiratory protection guidelines to select proper respiratory protection.

Eye Protection: Wear industrial safety glasses with side shields and /or goggles or faceshield as necessary for conditions. Comply with the requirements of OSHA 29 CFR 1910.133.

Skin Protection: Use impervious, chemical resistant gloves when handling. Depending on working conditions, i.e., contact potential, wear chemical resistant protective garments such as head/neck cover, aprons, jackets, coveralls, or long sleeved shirts and long pants, boots, long pants, chemical resistant overshoes, etc.

Section 9 --- Physical and Chemical Properties

Physical State: Liquid.

Appearance/Odor: Brown to black. Tar odor.

Solubility: Slightly soluble in water.

Specific Gravity (H₂O=1): 1.05

Boiling Point: >180°C (>355°F)

Melting Point: NA

Flash Point: >200°F

Vapor Pressure: 1 mm at 30°C

Vapor Density (Air = 1): >1

Evaporation Rate (Ether = 1): slow

Viscosity: ND

pH: ND

Section 10 --- Stability and Reactivity

Stability: Product is stable.

Polymerization: Hazardous polymerization will not occur.

Chemical Incompatibilities: None known.

Conditions to Avoid: Overheating.

Hazardous Decomposition Products: Oxides of carbon and other toxic vapors.

Section 11 --- Disposal Considerations

Dispose of in accordance with local, state, and federal regulations.

Section 12 --- Transport Information

U.S. Department of Transportation (DOT) regulations - 49 Code of Federal Regulations (CFR)

Shipping Name: RQ Environmentally Hazardous Substance, liquid, n.o.s., (Coal Tar Distillate, contains Benzene, Naphthalene)

Label: Class 9

ID No.: NA 3082

Hazard Class: 9

Packing Group: III

Special Provisions: None

Quantity Limitations –

Passenger Aircraft or Railcar: None

Cargo Aircraft Only: None

Vessel Stowage: Area A

Non-Bulk Packaging: See 173.203

Packaging Exceptions: See 173.155

Bulk Packaging: See 173.241

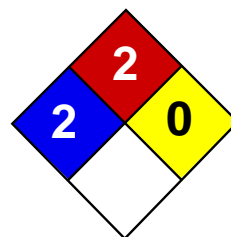
Section 13 --- Regulatory Information

Component	OSHA Hazardous Chemical	CERCLA Reportable Quantity (lbs)	Extremely Hazardous Substance (40 CFR 355)	CAA Section 112 TQ	SARA Section 313
Coal Tar Distillate	YES	1	---	---	---
Indene	YES	---	---	---	---
Naphthalene	YES	100	---	---	YES
Biphenyl	YES	100	---	---	YES
Benzene	YES	10	---	---	YES
Alkyl naphthalene	YES	---	---	---	---
Phenanthrene	YES	5,000	---	---	YES
Benz(a)anthracene	YES	10	---	---	YES*
Benzo(a)phenanthrene	YES	100	---	---	---
Benzo(b)fluoranthene	YES	1	---	---	YES*
Benzo(j)fluoranthene	YES	---	---	---	YES*
Benzo(k)fluoranthene	YES	5,000	---	---	YES*
7,12-Dimethylbenz(a)anthracene	YES	1	---	---	YES*
Indeno(1,2,3-cd)pyrene	YES	100	---	---	YES*
Benzo(a)pyrene	YES	1	---	---	YES*
Dibenz(a,h)anthracene	YES	1	---	---	YES*
Benzo(g,h,i)perylene	YES	10	---	---	YES
7-H Dibenz(o,c,g)carbazole	YES	---	---	---	YES*
Dibenzo(a,l)pyrene	YES	---	---	---	YES*
1-Nitropyrene	YES	---	---	---	YES*
Dibenz(a,j)acridine	YES	---	---	---	YES*
Dibenz(a,h)acridine	YES	---	---	---	YES*

* = Polycyclic Aromatic Compounds (PAC) category TRI threshold = 100 lbs.

Section 14 --- Other Information

Prepared by John E. Francis, CIH, CSP
Prepared 9/05, Revision 1 (1/27/06).



Health	2
Fire	2
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Naphthalene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Naphthalene

Catalog Codes: SLN1789, SLN2401

CAS#: 91-20-3

RTECS: QJ0525000

TSCA: TSCA 8(b) inventory: Naphthalene

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C₁₀H₈

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Naphthalene	91-20-3	100

Toxicological Data on Ingredients: Naphthalene: ORAL (LD50): Acute: 490 mg/kg [Rat]. 533 mg/kg [Mouse]. 1200 mg/kg [Guinea pig]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit]. VAPOR (LC50): Acute: 170 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant, permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE]. The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:

After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 567°C (1052.6°F)

Flash Points: CLOSED CUP: 88°C (190.4°F). OPEN CUP: 79°C (174.2°F).

Flammable Limits: LOWER: 0.9% UPPER: 5.9%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

Flammable solid. **SMALL FIRE:** Use DRY chemical powder. **LARGE FIRE:** Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:

Flammable solid. Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:

Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

Israel: TWA: 10 (ppm) TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [1995] TWA: 52 STEL: 79 (mg/m3) from ACGIH [1995]
Australia: STEL: 15 (ppm) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid.)

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 128.19 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 218°C (424.4°F)

Melting Point: 80.2°C (176.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.162 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 4.4 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.038 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties:

Partially dispersed in hot water, methanol, n-octanol. Very slightly dispersed in cold water. See solubility in methanol, n-octanol.

Solubility:

Partially soluble in methanol, n-octanol. Very slightly soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Highly reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: May attack some forms of rubber and plastic

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 490 mg/kg [Rat]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 170 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE]. The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS).

Other Toxic Effects on Humans:

Very hazardous in case of ingestion. Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 305.2 ppm 96 hour(s) [Trout].

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Naphthalene, refined : UN1334 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:

Rhode Island RTK hazardous substances: Naphthalene Pennsylvania RTK: Naphthalene Florida: Naphthalene Minnesota: Naphthalene Massachusetts RTK: Naphthalene TSCA 8(b) inventory: Naphthalene TSCA 8(a) PAIR: Naphthalene TSCA 8(d) H and S data reporting: Naphthalene: 06/01/87 SARA 313 toxic chemical notification and release reporting: Naphthalene: 1% CERCLA: Hazardous substances.: Naphthalene: 100 lbs. (45.36 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-4: Flammable solid. CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

R36- Irritating to eyes. R40- Possible risks of irreversible effects. R48/22- Harmful: danger of serious damage to health by prolonged exposure if swallowed. R48/23- Toxic: danger of serious damage to health by prolonged exposure through inhalation. R63- Possible risk of harm to the unborn child.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 2

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

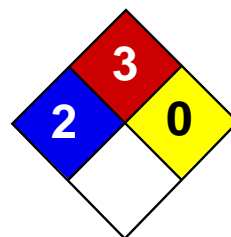
References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 01:30 PM

Last Updated: 11/01/2010 12:00 PM

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Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C₆-H₆

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances:

Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:

Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:

Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powerful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Vigorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:

Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimanganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powerful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:

Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:

Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powerful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. **MUTAGENIC EFFECTS:** Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. **DEVELOPMENTAL TOXICITY:** Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:

Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism, and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S46- If swallowed, seek medical advice immediately and show this container or label. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

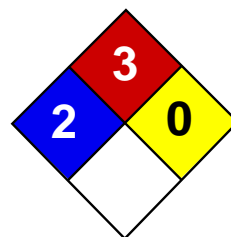
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:35 PM

Last Updated: 11/01/2010 12:00 PM

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Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C₈H₁₀

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD₅₀): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (irritant, sensitizer). **CARCINOGENIC EFFECTS:** Classified 2B (Possible for human.) by IARC. **MUTAGENIC EFFECTS:** Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. **TERATOGENIC EFFECTS:** Not available. **DEVELOPMENTAL TOXICITY:** Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:

CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001) CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001) CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:

Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:

Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States] TWA: 435 STEL: 545 from OSHA (PEL) [United States] TWA: 435 STEL: 545 (mg/m³) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States] TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)] TWA: 100 STEL: 125 (ppm) [Belgium] TWA: 100 STEL: 125 (ppm) [Finland] TWA: 50 (ppm) [Norway] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; $\log(\text{oil/water}) = 3.1$

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:

Easily soluble in diethyl ether. Very slightly soluble in cold water or practically insoluble in water. Soluble in all proportions in Ethyl alcohol. Soluble in Carbon tetrachloride, Benzene. Insoluble in Ammonia. Slightly soluble in Chloroform. Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:

Can react vigorously with oxidizing materials. Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:

Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:

Lethal Dose/Conc 50% Kill: LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg Lowest Published Lethal Dose/Conc: LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Can cause mild skin irritation. It can be absorbed through intact skin. Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm, it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS) Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include

headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and consciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987). Ingestion: Do not drink, pipet or siphon by mouth. May cause gastrointestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:

Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through). 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Ethylbenzene Illinois toxic substances disclosure to employee act: Ethylbenzene Illinois chemical safety act: Ethylbenzene New York release reporting list: Ethylbenzene Rhode Island RTK hazardous substances: Ethylbenzene Pennsylvania RTK: Ethylbenzene Minnesota: Ethylbenzene Massachusetts RTK: Ethylbenzene Massachusetts spill list: Ethylbenzene New Jersey: Ethylbenzene New Jersey spill list: Ethylbenzene Louisiana spill reporting: Ethylbenzene California Director's List of Hazardous Substances: Ethylbenzene TSCA 8(b) inventory: Ethylbenzene TSCA 4(a) proposed test rules: Ethylbenzene TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97 SARA 313 toxic chemical notification and release reporting: Ethylbenzene

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information**References:**

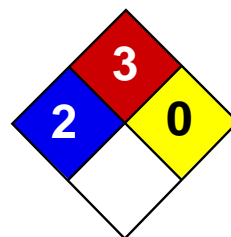
-Manufacturer's Material Safety Data Sheet. -Fire Protection Guide to Hazardous Materials, 13th ed., National Fire Protection Association (NFPA) -Registry of Toxic Effects of Chemical Substances (RTECS) -Chemical Hazard Response Information System (CHRIS) -Hazardous Substance Data Bank (HSDB) -New Jersey Hazardous Substance Fact Sheet -Ariel Global View -Reprotext System

Other Special Considerations: Not available.

Created: 10/09/2005 05:28 PM

Last Updated: 11/01/2010 12:00 PM

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Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C₆H₅CH₃ or C₇H₈

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC.

MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances:

Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:

Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetroxide; concentrated nitric acid, sulfuric acid + nitric acid; N₂O₄; AgClO₄; BrF₃; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage**Precautions:**

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection**Engineering Controls:**

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; $\log(\text{oil/water}) = 2.7$

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:

Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:

Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:

Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:

Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Causes mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abrasions. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. **Chronic Potential Health Effects:** Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophosphatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:

Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

toxic substances disclosure to employee act: Toluene Illinois chemical safety act: Toluene New York release reporting list: Toluene Rhode Island RTK hazardous substances: Toluene Pennsylvania RTK: Toluene Florida: Toluene Minnesota: Toluene Michigan critical material: Toluene Massachusetts RTK: Toluene Massachusetts spill list: Toluene New Jersey: Toluene New Jersey spill list: Toluene Louisiana spill reporting: Toluene California Director's List of Hazardous Substances.: Toluene TSCA 8(b) inventory: Toluene TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92 SARA 313 toxic chemical notification and release reporting: Toluene CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S29- Do not empty into drains. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

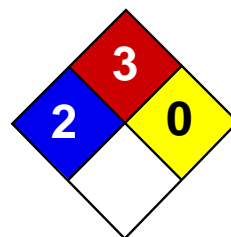
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:30 PM

Last Updated: 11/01/2010 12:00 PM

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Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Xylenes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Xylenes

Catalog Codes: SLX1075, SLX1129, SLX1042, SLX1096

CAS#: 1330-20-7

RTECS: ZE2100000

TSCA: TSCA 8(b) inventory: Xylenes

CI#: Not available.

Synonym: Xylenes; Dimethylbenzene; xylol; methyltoluene

Chemical Name: Xylenes (o-, m-, p- isomers)

Chemical Formula: C₆H₄(CH₃)₂

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Xylenes	1330-20-7	100

Toxicological Data on Ingredients: Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 24°C (75.2°F). (Tagliabue.) OPEN CUP: 37.8°C (100°F).

Flammable Limits: LOWER: 1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances:

Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:

Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Vapors may travel to source of ignition and flash back.

Special Remarks on Explosion Hazards:

Vapors may form explosive mixtures with air. Containers may explode when heated. May polymerize explosively when heated. An attempt to chlorinate xylene with 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin) caused a violent explosion

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 100 (ppm) [Canada] TWA: 435 (mg/m³) [Canada] TWA: 434 STEL: 651 (mg/m³) from ACGIH (TLV) [United States]
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 138.5°C (281.3°F)

Melting Point: -47.4°C (-53.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.864 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 1 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; $\log(\text{oil/water}) = 3.1$

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:

Insoluble in cold water, hot water. Miscible with absolute alcohol, ether, and many other organic liquids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Store away from acetic acid, nitric acid, chlorine, bromine, and fluorine.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2119 mg/kg [Mouse]. Acute dermal toxicity (LD50): >1700 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5000 4 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:

Lowest Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Man] - Route: Oral; Dose: 10000 ppm/6H

Special Remarks on Chronic Effects on Humans:

Detected in maternal milk in human. Passes through the placental barrier in animal. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects (male and female fertility (spontaneous abortion and fetotoxicity)) and birth defects based animal data.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes skin irritation. Can be absorbed through skin. Eyes: Causes eye irritation. Inhalation: Vapor causes respiratory tract and mucous membrane irritation. May affect central nervous system and behavior (General anesthetic/CNS depressant with effects including headache, weakness, memory loss, irritability, dizziness, giddiness, loss of coordination and judgement, respiratory depression/arrest or difficulty breathing, loss of appetite, nausea, vomiting, shivering, and possible coma and death). May also affects blood, sense organs, liver, and peripheral nerves. Ingestion: May cause gastrointestinal irritation including abdominal pain, vomiting, and nausea. May also affect liver and urinary system/kidneys. May cause effects similar to those of acute inhalation. Chronic Potential Health Effects: Chronic inhalation may affect the urinary system (kidneys) blood (anemia), bone marrow (hyperplasia of bone marrow) brain/behavior/Central Nervous system. Chronic inhalation may also cause mucosal bleeding. Chronic ingestion may affect the liver and metabolism (loss of appetite) and may affect urinary system (kidney damage)

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylenes UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Xylenes Illinois chemical safety act: Xylenes New York acutely hazardous substances: Xylenes Rhode Island RTK hazardous substances: Xylenes Pennsylvania RTK: Xylenes Minnesota: Xylenes Michigan critical material: Xylenes Massachusetts RTK: Xylenes Massachusetts spill list: Xylenes New Jersey: Xylenes New Jersey spill list: Xylenes Louisiana spill reporting: Xylenes California Director's List of Hazardous Substances: Xylenes TSCA 8(b) inventory: Xylenes SARA 302/304/311/312 hazardous chemicals: Xylenes SARA 313 toxic chemical notification and release reporting: Xylenes CERCLA: Hazardous substances.: Xylenes: 100 lbs. (45.36 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R10- Flammable. R21- Harmful in contact with skin. R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

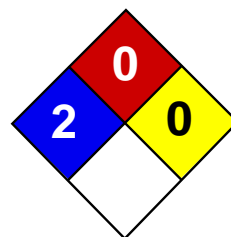
References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 12:54 PM

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Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Bentonite MSDS

Section 1: Chemical Product and Company Identification

Product Name: Bentonite

Catalog Codes: SLB1441, SLB2935, SLB4435

CAS#: 1302-78-9

RTECS: CT9450000

TSCA: TSCA 8(b) inventory: Bentonite

CI#: Not applicable.

Synonym: Montmorillonite;

Chemical Name: Not available.

Chemical Formula:

(Al,Fe1.67Mg.33)Si10(OH)2Na(+)Ca(++)/2.33

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Bentonite	1302-78-9	100

Toxicological Data on Ingredients: Bentonite LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.

Potential Chronic Health Effects:

Hazardous in case of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Do not breathe dust. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 10 from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Odorless.

Taste: Not available.

Molecular Weight: Not available.

Color: Beige. (Light.)

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: Decomposes.

Critical Temperature: Not available.

Specific Gravity: 2.5 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:

Very slightly soluble in cold water, hot water. Insoluble in methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Not available.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Causes damage to the following organs: lungs.

Other Toxic Effects on Humans:

Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Bentonite

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:14 PM

Last Updated: 11/01/2010 12:00 PM

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MATERIAL SAFETY DATA SHEET (MSDS) FOR PORTLAND CEMENT

(Complies with OSHA and MSHA Hazard Communication Standards,
29 CFR 1910.1200 and 30 CFR Part 47)



**CEMEX, INC.
CEMEX CALIFORNIA CEMENT LLC
VICTORVILLE CEMENT PLANT
16888 NORTH "E" STREET
VICTORVILLE, CALIFORNIA 92394-2999**

Section 1 - IDENTIFICATION

Supplier/Manufacturer

CEMEX, Inc.
CEMEX California Cement LLC
Victorville Cement Plant
16888 North "E" Street
Victorville, California 92394-2999

Emergency Contact Information

(619) 381-7600

Chemical name and synonyms

Portland Cement (CAS #65997-15-1)

Product name

"CEMEX Type I/II"
"CEMEX Type III"
"CEMEX Type II/V"
"CEMEX Type V"
"CEMEX Block"
"CEMEX Class G"

Chemical family

Calcium salts.

Formula

3CaO.SiO ₂	(CAS #12168-85-3)
2CaO.SiO ₂	(CAS #10034-77-2)
3CaO.Al ₂ O ₂	(CAS #12042-78-3)
4CaO..Al ₂ O ₃ Fe ₂ O ₃	(CAS #12068-35-8)
CaSO ₂ .2H ₂ O	(CAS #13397-24-5)

Other salts:

Small amounts of MgO, and trace amounts of K₂SO₄ and Na₂SO₄ may also be present.

Section 2 - COMPONENTS

Hazardous Ingredients

Portland cement clinker (CAS# 65997-15- 1) - approximately - 93.5-96.0 % by weight

ACGIH TLV-TWA (2000) = 10 mg total dust/m³

OSHA PEL (8-hour TWA) = 50 million particles/ft³

Gypsum (CAS# 7778-18-9) - approximately - 4.0-6.5 % by weight

ACGIH TLV-TWA (2000) = 10 mg total dust/m³

OSHA PEL (8-hour TWA) = 15 mg total dust/m³

OSHA PEL (8-hour TWA) = 5 mg respirable dust/m³

Respirable quartz (CAS# 14808-60-7) – greater than 0.1% by weight

ACGIH TLV-TWA (2000) = 0.05 mg respirable quartz dust/m³

OSHA PEL (8-hour TWA) = (10 mg respirable dust/m³)/(percent silica + 2)

Trace Ingredients

Trace amounts of naturally occurring chemicals might be detected during chemical analysis. Trace constituents may include up to 0.75% insoluble residue, some of which may be free crystalline silica, calcium oxide (Also known as lime or quick lime), magnesium oxide, potassium sulfate, sodium sulfate, chromium compounds, and nickel compounds.

Section 3 - HAZARD IDENTIFICATION

Emergency Overview

Portland cement is a light gray powder that poses little immediate hazard. A single short-term exposure to the dry powder is not likely to cause serious harm. However, exposure of sufficient duration to wet portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns. The same type of tissue destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry portland cement.

Potential Health Effects

Relevant Routes of Exposure:

Eye contact, skin contact, inhalation, and ingestion.

Effects Resulting from Eye Contact:

Exposure to airborne dust may cause immediate or delayed irritation or inflammation. Eye contact by large amounts of dry powder or splashes of wet portland cement may cause effects ranging from moderate eye irritation to chemical burns or blindness. Such exposures require immediate first aid (see Section 4) and medical attention to prevent significant damage to the eye.

Effects Resulting from Skin Contact:

Discomfort or pain cannot be relied upon to alert a person to hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing skin contact, particularly with wet cement. Exposed persons may not feel discomfort until hours after the exposure has ended and significant injury has occurred.

Dry portland cement contacting wet skin or exposure to moist or wet portland cement may cause more severe skin effects including thickening, cracking or fissuring of the skin. Prolonged exposure can cause severe skin damage in the form of (alkali) chemical burns.

Some individuals may exhibit an allergic response upon exposure to portland cement, possibly due to trace elements of chromium. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may first experience this effect after years of contact with portland cement products.

Effects Resulting from Inhalation:

Portland cement may contain trace amounts of free crystalline silica. Prolonged exposure to respirable free silica can aggravate other lung conditions and cause silicosis, a disabling and potentially fatal lung disease.

Exposure to portland cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.

Effects Resulting from Ingestion:

Although small quantities of dust are not known to be harmful, ill effects are possible if larger quantities are consumed. Portland cement should not be eaten.

Carcinogenic potential:

Portland cement is **not** listed as a carcinogen by NTP, OSHA, or IARC. It may however, contain trace amounts of substances listed as carcinogens by these organizations.

Crystalline silica, a potential trace level contaminate in Portland cement, is now classified by IARC as known human carcinogen (Group I). NTP has characterized respirable silica as "reasonably anticipated to be [a] carcinogen".

Medical conditions which may be aggravated by, inhalation or dermal exposure:

Pre-existing upper respiratory and lung diseases.

Unusual (hyper) sensitivity to hexavalent chromium (chromium⁺⁶) salts.

Section 4 - FIRST AID

Eyes

Immediately flush eyes thoroughly with water. Continue flushing eye for at least 15 minutes, including under lids, to remove all particles. Call physician immediately.

Skin

Wash skin with cool water and pH-neutral soap or a mild detergent. Seek medical treatment in all cases of prolonged exposure to wet cement, cement mixtures, liquids from fresh cement products, or prolonged wet skin exposure to dry cement.

Inhalation of Airborne Dust

Remove to fresh air. Seek medical help if coughing and other symptoms do not subside.

Ingestion

Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

Section 5 - FIRE AND EXPLOSION DATA

Flash point	None	Lower Explosive Limit.....	None
Upper Explosive Limit.....	None	Auto ignition temperature.....	Not Combustible
Extinguishing media.....	Not Combustible	Special fire fighting Procedures.....	None
Hazardous combustion products.....	None	Unusual fire and explosion hazards....	None

Section 6 - ACCIDENTAL RELEASE MEASURES

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Wear appropriate personal protective equipment as described in Section 8.

Scrape up wet material and place in an appropriate container. Allow the material to "dry" before disposal. Do not attempt to wash portland cement down drains.

Dispose of waste material according to local, state and federal regulations.

Section 7 - HANDLING AND STORAGE

Keep portland cement dry until used. Normal temperatures and pressures do not affect the material.

Promptly remove dusty clothing or clothing which is wet with cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet cement mixtures or fluids.

Section 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Skin Protection

Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened portland cement. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened portland cement products might occur, wear impervious clothing and gloves to eliminate skin contact. Wear sturdy boots that are impervious to water to eliminate foot and ankle exposure.

Do not rely on barrier creams: barrier creams should not be used in place of gloves.

Periodically wash areas contacted by dry portland cement or by wet cement or concrete fluids with a pH neutral soap. Wash again at the end of work. If irritation occurs, immediately wash the affected area and seek treatment. If clothing becomes saturated with wet concrete, it should be removed and replaced with clean dry clothing.

Respiratory Protection

Avoid actions that cause dust to become airborne. Use local or general exhaust ventilation to control exposures below applicable exposure limits.

Use NIOSH/MSHA approved (under 30 CFR 11) or NIOSH approved (under 42 CFR 84) respirators in poorly ventilated areas, if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. (Advisory: Respirators and filters purchased after June 10, 1998 must be certified under 42 CFR 84.)

Ventilation

Use local exhaust or general dilution ventilation to control exposure within applicable limits.

Eye Protection

Where potentially subject to splashes or puffs of cement, wear safety glasses with side shields or goggles. In extremely dusty environments and unpredictable environments wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with portland cement or fresh cement products.

Section 9 - PHYSICAL AND CHEMICAL, PROPERTIES

Appearance.....	Gray Powder	Odor.....	No distinct odor
Physical state.....	Solid (powder)	pH (in water).....	12 to 13
Solubility in water...	Slightly soluble (0.1 to 1.0%)	Vapor pressure.....	Not applicable
Vapor density.....	Not applicable	Boiling point.....	Not applicable (i.e., > 1000 C)
Melting point.....	Not applicable	Specific gravity (H2O = 1.0).....	3.15
Evaporation rate.....	Not applicable		

Section 10 - STABILITY AND REACTIVITY

Stability

Stable.

Conditions to avoid

Unintentional contact with water.

Incompatibility

Wet Portland cement is alkaline. As such it is incompatible with acids, ammonium salts and phosphorous.

Hazardous decomposition

Will not spontaneously occur. Adding water produces (caustic) calcium hydroxide

Hazardous Polymerization

Will not occur.

Section 11 - TOXICOLOGICAL INFORMATION

For a description of available, more detailed toxicological information contact the supplier or manufacturer.

Section 12 - ECOLOGICAL INFORMATION

Ecotoxicity

No recognized unusual toxicity to plants or animals

Relevant physical and chemical properties

(See Sections 9 and 10.)

Section 13 - DISPOSAL

Dispose of waste material according to local, state and federal regulations. (Since portland cement is stable, uncontaminated material may be saved for future use.

Dispose of bags in an approved landfill or incinerator.

Section 14 - TRANSPORTATION DATA

Hazardous materials description/proper shipping name

Portland cement is not hazardous under U.S. Department of Transportation (DOT) regulations.

Hazard class

Not applicable

Identification number

Not applicable.

Required label text

Not applicable.

Hazardous substances/reportable quantities (RQ)

Not applicable.

Section 15 - OTHER REGULATORY INFORMATION

Status under USDOL-OSHA Hazard Communication Rule, 29 CFR 1910.1200

Portland cement is considered a "hazardous chemical" under this regulation, and should be part of any hazard communication program.

Status under CERCLA/SUPERFUND 40 CFR 117 and 302

Not listed.

Hazard Category under SARA(Title III), Sections 311 and 312

Portland cement qualifies as a "hazardous substance" with delayed health effects.

Status under SARA (Title III), Section 313

Not subject to reporting requirements under Section 313.

Status under TSCA (as of May 1997)

Some substances in portland cement are on the TSCA inventory list.

Status under the Federal Hazardous Substances Act

Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.

Status under California Proposition 65

This product contains up to 0.05 percent of chemicals (trace elements) known to the State of California to cause cancer, birth defects or other reproductive harm. California law requires the manufacturer to give the above warning in the absence of definitive testing to prove that the defined risks do not exist.

Section 16 - OTHER INFORMATION

Prepared by

Kevin Keegan
Director - Health and Safety
CEMEX, Inc.
Houston, Texas

Approval date or Revision date

Approved: August, 1997
Revised: March, 2001

Other important information

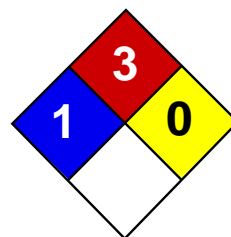
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Portland cement should only be used by knowledgeable persons. A key to using the product safely requires the user to recognize that portland cement chemically reacts with water, and that some of the intermediate products of this reaction (that is those present while a portland cement product is "setting") pose a more severe hazard than does dry portland cement itself.

While the information provided in this material safety data sheet is believed to provide a useful summary of the hazards of portland cement as it is commonly used, the sheet cannot anticipate and provide the all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

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In particular, the data furnished in this sheet do not address hazards that may be posed by other materials mixed with portland cement to produce portland cement products. Users should review other relevant material safety data sheets before working with this portland cement or working on portland cement products, for example, portland cement concrete.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Acetone MSDS

Section 1: Chemical Product and Company Identification

Product Name: Acetone

Catalog Codes: SLA3502, SLA1645, SLA3151, SLA3808

CAS#: 67-64-1

RTECS: AL3150000

TSCA: TSCA 8(b) inventory: Acetone

CI#: Not applicable.

Synonym: 2-propanone; Dimethyl Ketone;
Dimethylformaldehyde; Pyroacetic Acid

Chemical Name: Acetone

Chemical Formula: C3-H6-O

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Acetone	67-64-1	100

Toxicological Data on Ingredients: Acetone: ORAL (LD50): Acute: 5800 mg/kg [Rat]. 3000 mg/kg [Mouse]. 5340 mg/kg [Rabbit]. VAPOR (LC50): Acute: 50100 mg/m 8 hours [Rat]. 44000 mg/m 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. The substance is toxic to central nervous system (CNS). The substance may be toxic to kidneys, the reproductive system, liver, skin. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 465°C (869°F)

Flash Points: CLOSED CUP: -20°C (-4°F). OPEN CUP: -9°C (15.8°F) (Cleveland).

Flammable Limits: LOWER: 2.6% UPPER: 12.8%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of oxidizing materials, of acids.

Fire Fighting Media and Instructions:

Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Vapor may travel considerable distance to source of ignition and flash back.

Special Remarks on Explosion Hazards:

Forms explosive mixtures with hydrogen peroxide, acetic acid, nitric acid, nitric acid + sulfuric acid, chromic anhydride, chromyl chloride, nitrosyl chloride, hexachloromelamine, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, thiodiglycol + hydrogen peroxide, potassium ter-butoxide, sulfur dichloride, 1-methyl-1,3-butadiene, bromoform, carbon, air, chloroform, thitriazylperchlorate.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:

Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage**Precautions:**

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, acids, alkalis.

Storage:

Store in a segregated and approved area (flammables area) . Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Keep away from direct sunlight and heat and avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection**Engineering Controls:**

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 500 STEL: 750 (ppm) from ACGIH (TLV) [United States] TWA: 750 STEL: 1000 (ppm) from OSHA (PEL) [United States] TWA: 500 STEL: 1000 [Australia] TWA: 1185 STEL: 2375 (mg/m3) [Australia] TWA: 750 STEL: 1500 (ppm) [United Kingdom (UK)] TWA: 1810 STEL: 3620 (mg/m3) [United Kingdom (UK)] TWA: 1800 STEL: 2400 from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Fruity. Mint-like. Fragrant. Ethereal

Taste: Pungent, Sweetish

Molecular Weight: 58.08 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 56.2°C (133.2°F)

Melting Point: -95.35 (-139.6°F)

Critical Temperature: 235°C (455°F)

Specific Gravity: 0.79 (Water = 1)

Vapor Pressure: 24 kPa (@ 20°C)

Vapor Density: 2 (Air = 1)

Volatility: Not available.

Odor Threshold: 62 ppm

Water/Oil Dist. Coeff.: The product is more soluble in water; $\log(\text{oil/water}) = -0.2$

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, ignition sources, exposure to moisture, air, or water, incompatible materials.

Incompatibility with various substances: Reactive with oxidizing agents, reducing agents, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 3000 mg/kg [Mouse]. Acute toxicity of the vapor (LC50): 44000 mg/m³ 4 hours [Mouse].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. Causes damage to the following organs: central nervous system (CNS). May cause damage to the following organs: kidneys, the reproductive system, liver, skin.

Other Toxic Effects on Humans:

Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

May affect genetic material (mutagenicity) based on studies with yeast (*S. cerevisiae*), bacteria, and hamster fibroblast cells. May cause reproductive effects (fertility) based upon animal studies. May contain trace amounts of benzene and formaldehyde which may cause cancer and birth defects. Human: passes the placental barrier.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: May cause skin irritation. May be harmful if absorbed through the skin. Eyes: Causes eye irritation, characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury. Inhalation: Inhalation at high concentrations affects the sense organs, brain and causes respiratory tract irritation. It also may affect the Central Nervous System (behavior) characterized by dizziness, drowsiness, confusion, headache, muscle weakness, and possibly motor incoordination, speech abnormalities, narcotic effects and coma. Inhalation may also affect the gastrointestinal tract (nausea, vomiting). Ingestion: May cause irritation of the digestive (gastrointestinal) tract (nausea, vomiting). It may also

affect the Central Nervous System (behavior), characterized by depression, fatigue, excitement, stupor, coma, headache, altered sleep time, ataxia, tremors as well as the blood, liver, and urinary system (kidney, bladder, ureter) and endocrine system. May also have musculoskeletal effects. Chronic Potential Health Effects: Skin: May cause dermatitis. Eyes: Eye irritation.

Section 12: Ecological Information

Ecotoxicity:

Ecotoxicity in water (LC50): 5540 mg/l 96 hours [Trout]. 8300 mg/l 96 hours [Bluegill]. 7500 mg/l 96 hours [Fathead Minnow]. 0.1 ppm any hours [Water flea].

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification : Acetone UNNA: 1090 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Benzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Benzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Benzene, Formaldehyde Connecticut hazardous material survey.: Acetone Illinois toxic substances disclosure to employee act: Acetone Illinois chemical safety act: Acetone New York release reporting list: Acetone Rhode Island RTK hazardous substances: Acetone Pennsylvania RTK: Acetone Florida: Acetone Minnesota: Acetone Massachusetts RTK: Acetone Massachusetts spill list: Acetone New Jersey: Acetone New Jersey spill list: Acetone Louisiana spill reporting: Acetone California List of Hazardous Substances (8 CCR 339): Acetone TSCA 8(b) inventory: Acetone TSCA 4(a) final test rules: Acetone TSCA 8(a) IUR: Acetone

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

R11- Highly flammable. R36- Irritating to eyes. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information**References:**

-Material safety data sheet issued by: la Commission de la Santé et de la Sécurité du Travail du Québec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. LOLI, RTECS, HSDB databases. Other MSDSs

Other Special Considerations: Not available.

Created: 10/10/2005 08:13 PM

Last Updated: 11/01/2010 12:00 PM

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MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations



SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **ALCONOX®**
CHEMICAL FAMILY NAME: Detergent.
PRODUCT USE: Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER: Not Applicable
U.N. DANGEROUS GOODS CLASS: Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME: Alconox, Inc.
ADDRESS: 30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE: **TOLL-FREE in USA/Canada** 800-255-3924
International calls 813-248-0585
BUSINESS PHONE: 914-948-4040
DATE OF PREPARATION: May 2011
DATE OF LAST REVISION: February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS



EUROPEAN and (GHS) Hazard Symbols



Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1

EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 207-638-8 Index# 011-005-00-2

EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breathe dust/fume/gas/mist/vapors/spray

P264: Wash hands thoroughly after handling

P271: Use only in well ventilated area.

P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

MATERIAL SAFETY DATA SHEET

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Risk Phrases:

R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:

S8: Keep container dry
S22: Do not breathe dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS:

ACUTE: Eye, respiratory System, Skin

CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard JIS Z 7250: 2000.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing difficulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

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SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT:

AUTOIGNITION TEMPERATURE:

FLAMMABLE LIMITS (in air by volume, %):

FIRE EXTINGUISHING MATERIALS:

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Explosion Sensitivity to Mechanical Impact:

Explosion Sensitivity to Static Discharge:

SPECIAL FIRE-FIGHTING PROCEDURES:

Not Flammable

Not Applicable

Lower (LEL): NA Upper (UEL): NA

As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

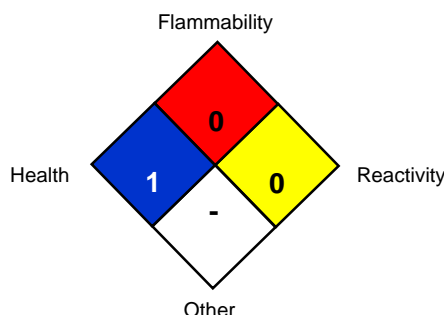
This product is non-flammable and has no known explosion hazards.

Not Sensitive.



Not Sensitive

Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD (BLUE)			1
FLAMMABILITY HAZARD (RED)			0
PHYSICAL HAZARD (YELLOW)			0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8
For Routine Industrial Use and Handling Applications			

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.

SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

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SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m ³	5 mg/m ³	5 mg/m ³
Sodium Carbonate	497-19-8	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

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SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable

DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m ³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m ³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.

SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: No Data available at this time.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Non-Regulated Material

HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable

UN IDENTIFICATION NUMBER: Not Applicable

PACKING GROUP: Not Applicable.

DOT LABEL(S) REQUIRED: Not Applicable

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable

MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:

This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:

This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):

This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:

This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

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This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory of Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

MATERIAL SAFETY DATA SHEET

ALCONOX®

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-in-place. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.



Material Safety Data Sheet Conductivity Standards

Section 1 - Chemical Product and Company Identification

MSDS Name:

Conductivity Standards

Catalog Numbers:

LC18750, LC18755, LC18760, LC18765, LC18771, LC18772, LC18773, LC18774, LC18775,
LC18777, LC18779, LC18780, LC18786, LC18787, LC18789, LC18791

Synonyms:

Potassium chloride solutions

Company Identification:

LabChem, Inc.
200 William Pitt Way
Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300 or 011-703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
7447-40-7	Potassium chloride	0.26-7.4
7732-18-5	Water	balance

Section 3 - Hazards Identification

Emergency Overview

Appearance: Clear, colorless solutions

Expected to be non-hazardous.

Target Organs: None known.

Potential Health Effects

Eye:

Non-irritating to the eyes.

Skin:

Non-irritating to the skin.

Ingestion:

No hazard is expected during normal use.

Inhalation:

No hazard expected during normal use.

Chronic:

No information found.



Material Safety Data Sheet Conductivity Standards

Section 4 - First Aid Measures

Eyes:

If irritation develops, get medical aid.

Skin:

Get medical aid if irritation develops or persists.

Ingestion:

Do NOT induce vomiting. Get medical aid.

Inhalation:

No specific treatment is necessary since this material is not likely to be hazardous by inhalation.

Notes to Physician:

Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Autoignition Temperature:

No information found.

Flash Point:

No information found.

NFPA Rating:

CAS# 7447-40-7: Health- 1, Flammability- 0, Instability- 1.

CAS# 7732-18-5: Health- 0, Flammability- 0, Instability- 0.

Explosion Limits:

Lower: n/a Upper: n/a

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spill using an absorbent, non-combustible material such as earth, sand, diatomaceous earth, vermiculite, or other suitable absorbent.

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Do not ingest or inhale. Avoid contact with eyes, skin and clothing.



Material Safety Data Sheet Conductivity Standards

Storage:

Store capped at room temperature.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Good general ventilation should be sufficient to control airborne levels.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Potassium chloride	None of the components are on this list.	None of the components are on this list.	None of the components are on this list.
Water	None of the components are on this list.	None of the components are on this list.	None of the components are on this list.

OSHA Vacated PELs:

None listed.

Personal Protective Equipment**Eyes:**

Wear safety glasses and chemical goggles if splashing is possible. Provide an eye-wash fountain in the immediate work area. Do not wear contact lenses when working with chemicals. Do not wear contact lenses when working with chemicals.

Skin:

Wear appropriate gloves to prevent skin contact.

Clothing:

Wear appropriate clothing to prevent skin contact.

Respirators:

Not required for normal use.

Section 9 - Physical and Chemical Properties

Physical State:	Liquid
Color:	Colorless
Odor:	Odorless
pH:	No information found.
Vapor Pressure:	14 mm Hg @ 20C
Vapor Density:	0.7 (water)
Evaporation Rate:	<Ether
Viscosity:	No information found.
Boiling Point:	212°F (100.00°C)
Freezing/Melting Point:	32°F (0.00°C)
Decomposition Temperature:	No information found.
Solubility in water:	Soluble.
Specific Gravity/Density:	1.0 – 1.1
Molecular Formula:	No information found.
Molecular Weight:	No information found.

Section 10 - Stability and Reactivity



Material Safety Data Sheet Conductivity Standards

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Temperatures above recommended temperatures.

Incompatibilities with Other Materials:

Strong oxidizing agents, strong acids, bromine trifluoride, sulfuric acid, potassium permanganate.

Hazardous Decomposition Products:

Hydrogen chloride, chlorine, potassium fume.

Hazardous Polymerization:

Will not occur.

Section 11 - Toxicological Information

RTECS:

CAS# 7447-40-7: TS8050000.

CAS# 7732-18-5: ZC0110000.

LD50/LC50:

CAS# 7447-40-7:

Oral, mouse: LD50 = 1500 mg/kg

Oral, rat: LD50 = 2600 mg/kg.

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg.

Carcinogenicity:

CAS# 7447-40-7: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

Epidemiology:

No information found.

Teratogenicity:

No information found.

Reproductive:

No information found.

Mutagenicity:

See actual entry in RTECS for complete information.

Neurotoxicity:

No information found.

Section 12 - Ecological Information

No information found.

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.



Material Safety Data Sheet Conductivity Standards

Section 14 - Transport Information

US DOT

Shipping Name: Not regulated.

Hazard Class:

UN Number:

Packing Group:

Section 15 - Regulatory Information

US Federal

TSCA:

CAS# 7447-40-7 is listed on the TSCA Inventory.

CAS# 7732-18-5 is listed on the TSCA Inventory.

SARA Reportable Quantities (RQ):

None of the components are on this list.

CERCLA/SARA Section 313:

None of the components are on this list.

OSHA - Highly Hazardous:

None of the components are on this list.

US State

State Right to Know:

None of the chemicals in this product are present on state Right-to-Know lists from California, Pennsylvania, New Jersey, Massachusetts, or Minnesota.

California Regulations:

None.

European/International Regulations

Canadian DSL/NDL:

CAS# 7447-40-7 is listed on Canada's DSL List.

CAS# 7732-18-5 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 7447-40-7 is not listed on Canada's Ingredient Disclosure List.

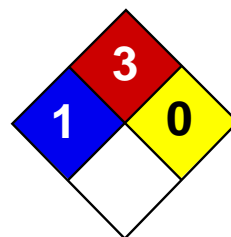
CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

Section 16 - Other Information

MSDS Creation Date: November 6, 1997

Revision Date: August 15, 2012

Information in this MSDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc. assumes no liability resulting from the use of this MSDS. The user must determine suitability of this information for his application.



Health	2
Fire	3
Reactivity	0
Personal Protection	G

Material Safety Data Sheet

Hexanes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hexanes

Catalog Codes: SLH2335, SLH2032

CAS#: 110-54-3

RTECS: MN9275000

TSCA: TSCA 8(b) inventory: Hexane

CI#: Not applicable.

Synonym:

Chemical Name: Hexane

Chemical Formula: C₆-H₁₄

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hexanes	110-54-3	98.5-99.9

Toxicological Data on Ingredients: Hexane: ORAL (LD50): Acute: 25000 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of skin contact (permeator), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to peripheral nervous system, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 225°C (437°F)

Flash Points: CLOSED CUP: -22.5°C (-8.5°F). (TAG)

Flammable Limits: LOWER: 1.15% UPPER: 7.5%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances:

Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards:

Extremely flammable liquid and vapor. Vapor may cause flash fire.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Flammable liquid, insoluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 500 (ppm) from OSHA (PEL) [United States] Inhalation TWA: 1800 (mg/m3) from OSHA (PEL) [United States] Inhalation TWA: 176 (mg/m3) from ACGIH (TLV) [United States] SKIN TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 500 STEL: 1000 (ppm) from ACGIH (TLV) [United States] Inhalation TWA: 1760 STEL: 3500 (mg/m3) from ACGIH (TLV) [United States] Inhalation Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Gasoline-like or petroleum-like (Slight.)

Taste: Not available.

Molecular Weight: 86.18g/mole

Color: Clear Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 68°C (154.4°F)

Melting Point: -95°C (-139°F)

Critical Temperature: Not available.

Specific Gravity: 0.66 (Water = 1)

Vapor Pressure: 17.3 kPa (@ 20°C)

Vapor Density: 2.97 (Air = 1)

Volatility: Not available.

Odor Threshold: 130 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.9

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:

Soluble in diethyl ether, acetone. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not available.

Special Remarks on Reactivity: Hexane can react vigorously with strong oxidizers (e.g. chlorine, bromine, fluorine)

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 25000 mg/kg [Rat]. Acute toxicity of the gas (LC50): 48000 ppm 4 hours [Rat].

Chronic Effects on Humans:

MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: peripheral nervous system, skin, central nervous system (CNS).

Other Toxic Effects on Humans:

Very hazardous in case of ingestion, of inhalation. Hazardous in case of skin contact (permeator). Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects based on animal data. May be tumorigenic based on animal data. May affect genetic material. Passes through the placental barrier in animal.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: May cause mild skin irritation. It can be absorbed through the skin in harmful amounts. Eyes: May cause mild eye irritation. Inhalation: May be harmful if inhaled. Inhalation of vapors may cause respiratory tract irritation. Overexposure may affect, brain, spinal cord, behavior/central and peripheral nervous systems (lightheadness, dizziness, hallucinations, paralysis, blurred vision, memory loss, headache, euphoria, general anesthetic, muscle weakness, numbness of the extremities, asphyxia, unconsciousness and possible death), metabolism, respiration, blood, cardiovascular system, gastrointestinal system (nausea) Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation with abdominal pain and nausea. May also affect the liver, blood, brain, peripheral and central nervous systems. Symptoms of over exposure by ingestion are similar to that of overexposure by inhalation.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations**Waste Disposal:**

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Hexane UNNA: 1208 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information**Federal and State Regulations:**

Connecticut hazardous material survey.: Hexanes Illinois toxic substances disclosure to employee act: Hexanes Illinois chemical safety act: Hexanes New York release reporting list: Hexanes Rhode Island RTK hazardous substances: Hexanes Pennsylvania RTK: Hexanes Florida: Hexanes Minnesota: Hexanes Massachusetts RTK: Hexanes Massachusetts spill list: Hexanes New Jersey: Hexanes New Jersey spill list: Hexanes Louisiana spill reporting: Hexanes TSCA 8(b) inventory: Hexanes SARA 313 toxic chemical notification and release reporting: Hexanes CERCLA: Hazardous substances.: Hexanes: 5000 lbs. (2268 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:**WHMIS (Canada):**

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

R11- Highly flammable. R20- Harmful by inhalation. R38- Irritating to skin. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. R62- Possible risk of impaired fertility. R65- Harmful: may cause lung damage if swallowed. R67- Vapors may cause drowsiness or dizziness. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S29- Do not empty into drains. S33- Take precautionary measures against static discharges. S36/37- Wear suitable protective clothing and gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets. S62- If swallowed, do not induce vomiting: seek medical advice immediately and show this

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves (impervious). Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

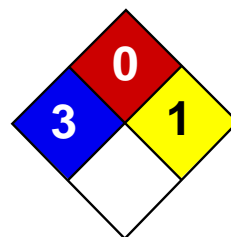
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:19 PM

Last Updated: 11/01/2010 12:00 PM

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Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammable gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrogen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl₄ Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca₃P₂ Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO₄ Hexalithium disilicide H₂SO₄ Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U₃P₄, Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m³) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m³) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m³) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:

108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:

-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:

1.1- 1.19 (Water = 1) 1.10 (20% and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38% HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:

Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothermic reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the following can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinum, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:

Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:

Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects (fetotoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjunctivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and laryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well as headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomiting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophageal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):

R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:

Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Industrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangereuses au Canada. Centre de conformité international Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 05:45 PM

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Product No. VT380

Tel: 412-826-5230

Emergency No. 800-424-9300

HAZARDOUS COMPONENTS	CAS NO.	OSHA PEL	ACGIH TLV	OTHER	%
Isopropyl Alcohol	CAS 67-63-0	400 PPM TWA	200 ppm TWA	500ppm STEL	70

DOT Labeling: Isopropyl Alcohol, Cls 3 (Flammable Liquid), UN 1219, PG II

PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: 180°F
Vapor Pressure (mmHg): 96 mm Hg at 100 , Deg F
Vapor Density (Air=1): 2.07
Specific Gravity (H2O=1): 0.850
Melting Point: Not Available
Evaporation Rate (Butyl Acetate=1): 2.3
Solubility in Water: Complete
Appearance/Color/Odor: Clear, colorless liquid with aromatic odor.

FIRE AND EXPLOSION HAZARD DATA

Flash Point: 54 Deg F
 Flammable limits: LEL 2.0%
 UEL 12.7%
 Extinguishing Media: Alcohol type foam, CO 2, or dry chemical.

Special fire fighting procedures: Use water to cool containers and to disperse vapors. Wear breathing apparatus and protective clothing.

Unusual fire and explosion hazards: Vapors form and may travel to open flames and sparks. Vapors may settle in low areas.

REACTIVITY DATA

Stability: Stable
Conditions to avoid: Storage at high temperatures.
Materials to avoid/Incompatibility: Oxidizing agents, nitric acid, and sulfuric acid.

Hazardous Decomposition/Byproducts: Carbon dioxide and carbon monoxide.
Hazardous Polymerization: Will not occur.

70% Isopropyl Alcohol, Isopropanol Continued.....

HEALTH HAZARD DATA

Routes of entry: Inhalation, skin, ingestion.

Health Hazards: Acute- Can cause nausea, vomiting, headache, drowsiness, drunken behavior, fatigue, weakness, confusion, abdominal pain, or coma.

Chronic-

Signs of Exposure: Nausea, vomiting, headache, drowsiness, dizziness, faintness, euphoria, decreased awareness, shortness of breath, leg cramps, visual disturbances, coma, or death.

Emergency and First Aid Procedures:

Eye Contact: Rinse with water for at least 15 minutes, seek medical attention.

Skin Contact: Wash with soap and water for 15 minutes.

Ingestion: If conscious, induce vomiting, seek medical help immediately.

Inhalation: Remove to fresh air assist breathing as necessary.

Medical Conditions Aggravated by Exposure: Respiratory, coronary, and liver conditions.

Carcinogenicity: None known.

PRECAUTIONS FOR SAFE HANDLING AND USE

Precautions to be taken in handling and storage: Store in a flammable safety cabinet or room. Use in a well-ventilated area, keep away from open flames sparks or sources of ignition.

Spill or Release Procedures: Absorb material with a non-flammable material such as sand, and place it in a sealed container. Notify personnel to clear area. Turn off any sources of flame or sparks.

Spill or Release: "Reportable Quantity" (RQ) to National Response Center 1-800-424-8802, 40 CFR Part 302: None

Waste Disposal Methods: In accordance with local, state, and federal regulations.

CONTROL MEASURES/PERSONAL PROTECTION

Respiratory Protection: If exposure limit is exceeded, a NIOSH approved respirator should be used.

Eye Protection: Goggles or full face shield.

Protective Gloves: Neoprene or PVC.

Protective Clothing: Outer garments not affected by the product.

Ventilation Requirements: Non sparking system.

Work and Hygienic Practices: Handle as a highly flammable liquid and wear appropriate personal safety equipment.

OTHER

NFPA Hazard Rating: Health- 1

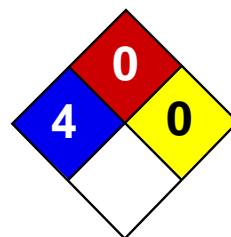
Flammability- 3

Reactivity- 0

KEY: 0-None, 1-Slight, 2-Moderate, 3-Severe, 4-Extreme

SARA TITLE III- In compliance with Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and 40 CFR Part 372 the following toxic chemicals are present: None.

THE ABOVE INFORMATION IS BELIEVED TO BE TRUE AND CORRECT AT THIS TIME. HOWEVER NO GUARANTEE IS EXPRESSED OR IMPLIED.



Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet

Nitric acid, 65% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric acid, 65%

Catalog Codes: SLN2161

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Nitric acid, fuming

CI#: Not applicable.

Synonym: Nitric Acid, 65%

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	35
Nitric acid, fuming	7697-37-2	65

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 244 ppm 0.5 hours [Rat]. 344 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, mucous membranes, upper respiratory

tract, skin, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of combustible materials

Explosion Hazards in Presence of Various Substances:

Explosive in presence of reducing materials, of organic materials, of metals, of alkalis. Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Flammable in presence of cellulose or other combustible materials. Phosphine, hydrogen sulfide, selenide all ignite when fuming nitric acid is dripped into gas. (Nitric Acid, fuming)

Special Remarks on Explosion Hazards:

Reacts explosively with metallic powders, carbides, cyanides, sulfides, alkalies and turpentine. Can react explosively with many reducing agents. Arsine, phosphine, tetraborane all oxidized explosively in presence of nitric acid. Cesium and rubidium

acetylides explode in contact with nitric acid. Explosive reaction with Nitric Acid + Nitrobenzene + water. Detonation with Nitric Acid + 4-Methylcyclohexane. (Nitric acid, fuming)

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid. Oxidizing material. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:

Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 2 STEL: 4 (ppm) from ACGIH (TLV) [United States] TWA: 2 STEL: 4 from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Acrid. Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point: 121°C (249.8°F)

Melting Point: -41.6°C (-42.9°F)

Critical Temperature: Not available.

Specific Gravity: 1.408 (Water = 1)

Vapor Pressure: 6 kPa (@ 20°C)

Vapor Density: 2.5 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.29 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in cold water, hot water. Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances:
Highly reactive with alkalis. Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper. Non-corrosive in presence of glass, of stainless steel(304), of stainless steel(316), of brass.

Special Remarks on Reactivity:
A strong oxidizer. Reacts violently with alcohol, organic material, turpene, charcoal. Violent reaction with Nitric acid + Acetone and Sulfuric acid. Nitric Acid will react with water or steam to produce heat and toxic, corrosive and flammable vapors. (Nitric acid, fuming)

Special Remarks on Corrosivity:
In presence of traces of oxides, it attacks all base metals except aluminum and special chromium steels. It will attack some forms of plastics, rubber, and coatings. No corrosive effect on bronze. No corrosivity data for zinc, and steel

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:

Contains material which may cause damage to the following organs: lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.

Other Toxic Effects on Humans:

Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: LDL - Lowest Published Lethal Dose [Human] - Route: Oral; Dose: 430 mg/kg (Nitric acid, fuming)

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects (effects on newborn and fetotoxicity) based on animal data. (Nitric acid, fuming)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Severely irritates skin. Causes skin burns and may cause deep and penetrating ulcers of the skin with a characteristic yellow to brownish discoloration. May be fatal if absorbed through skin. Eyes: Severely irritates eyes. Causes eye burns. May cause irreversible eye injury. Ingestion: May be fatal if swallowed. Causes serious gastrointestinal tract irritation or burns with nausea, vomiting, severe abdominal pain, and possible "coffee grounds" appearance of the vomitus . May cause perforation of the digestive tract. Inhalation: May be fatal if inhaled. Vapor is extremely hazardous. Vapor may cause nitrous gas poisoning. Effects may be delayed. May cause irritation of the mucous membranes and respiratory tract with burning pain in the nose and throat, coughing, sneezing, wheezing, shortness of breath and pulmonary edema. Other symptoms may include nausea, and vomiting. Chronic Potential Health Effects: Repeated inhalation may produce changes in pulmonary function and/or chronic bronchitis. It may also affect behavior (headache, dizziness, drowsiness, muscle contraction or spasticity, weakness, loss of coordination, mental confusion), and urinary system (kidney failure, decreased urinary output after several hours of

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Nitric acid UNNA: 2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:

New York release reporting list: Nitric acid, fuming Rhode Island RTK hazardous substances: Nitric acid, fuming Pennsylvania RTK: Nitric acid, fuming Florida: Nitric acid, fuming Minnesota: Nitric acid, fuming Massachusetts RTK: Nitric acid, fuming

New Jersey: Nitric acid, fuming TSCA 8(b) inventory: Water; Nitric acid, fuming SARA 302/304/311/312 extremely hazardous substances: Nitric acid, fuming SARA 313 toxic chemical notification and release reporting: Nitric acid, fuming 65% CERCLA: Hazardous substances.: Nitric acid, fuming: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):

CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):

R8- Contact with combustible material may cause fire. R35- Causes severe burns. S23- Do not breathe gas/fumes/vapour/spray [***] S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S36- Wear suitable protective clothing. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 4

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 10:59 AM

Last Updated: 11/01/2010 12:00 PM

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Material Safety Data Sheet

Buffer Solution pH 10.0

Section 1 - Chemical Product and Company Identification

MSDS Name:

Buffer Solution pH 10.0

Catalog Numbers:

LC12500, LC12510

Synonyms:

None

Company Identification:

LabChem Inc
200 William Pitt Way
Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300

Section 2 – Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
7732-18-5	Water	balance
1310-73-2	Sodium hydroxide	<1
1303-96-4	Sodium tetraborate, decahydrate	0.5
None	Non-toxic blue dye (LC12510 only)	<0.1

Section 3 - Hazards Identification

Emergency Overview

Appearance: LC12500: clear, colorless solution; LC12510: clear, blue solution**Caution!** May cause eye and skin irritation.**Target Organs:** None.

Potential Health Effects

Eye:

May cause eye irritation.

Skin:

May cause skin irritation.

Ingestion:

May cause gastrointestinal irritation with nausea and vomiting.

Inhalation:

May cause respiratory tract irritation.



Material Safety Data Sheet

Buffer Solution pH 10.0

Chronic:

Repeated ingestion may cause anorexia, irritation to gastrointestinal tract, nausea, vomiting, diarrhea, or skin rashes.

Section 4 - First Aid Measures

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid at once. Do NOT allow victim to rub or keep eyes closed.

Skin:

Get medical aid at once. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

Ingestion:

Call a poison control center. If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical aid at once.

Inhalation:

Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Autoignition Temperature:

Not applicable.

Flash Point:

Not applicable.

NFPA Rating:

Health- 1, Flammability- 0, Instability- 0.

Explosion Limits:

Lower: n/a Upper: n/a

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spills with absorbent (vermiculite, sand, fuller's earth) and place in suitable containers labeled for later disposal.



Material Safety Data Sheet

Buffer Solution pH 10.0

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Avoid breathing dust, vapor, mist, or gas.

Storage:

Store capped at room temperature. Protect from heat and incompatibles.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations below the Permissible Exposure Limits.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Water	none listed	none listed	none listed
Sodium hydroxide	2 mg/m3 Ceiling	10 mg/m3 IDLH	2 mg/m3 TWA
Sodium tetraborate	2 mg/m3 TWA (inhalable fraction, listed under Borate compounds, inorganic); 6 mg/m3 STEL (inhalable fraction, listed under Borate compounds, inorganic)	5 mg/m3 TWA	none listed

OSHA Vacated PELs:

Sodium tetraborate decahydrate: 10 mg/m3 TWA

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:

Wear appropriate gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Color: LC12500: colorless, LC12510: blue
Odor: Odorless



Material Safety Data Sheet

Buffer Solution pH 10.0

pH:	10.0
Vapor Pressure:	Not available
Vapor Density:	Not available
Evaporation Rate:	Not available
Viscosity:	Not available
Boiling Point:	Not available
Freezing/Melting Point:	Not available
Decomposition Temperature:	Not available
Solubility in water:	Soluble
Specific Gravity/Density:	1.0
Molecular Formula:	Not applicable
Molecular Weight:	Not applicable

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials.

Incompatibilities with Other Materials:

Strong oxidizers, acids.

Hazardous Decomposition Products:

Oxides of sodium and boron.

Hazardous Polymerization:

Has not been reported.

Section 11 - Toxicological Information

RTECS:

CAS# 7732-18-5: ZC0110000.

CAS# 1310-73-2: WB4900000.

CAS# 1303-96-4: VZ2275000.

LD50/LC50:

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg.

CAS# 1310-73-2:

No information found.

CAS# 1303-96-4:

Oral, mouse: LD50 = 2 gm/kg

Oral, rat: LD50 = 2660 mg/kg.

Carcinogenicity:

CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

CAS# 1310-73-2: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

CAS# 1303-96-4: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.



Material Safety Data Sheet Buffer Solution pH 10.0

Epidemiology:

No information found

Teratogenicity:

No information found

Reproductive:

No information found

Mutagenicity:

No information found

Neurotoxicity:

No information found

Section 12 - Ecological Information

No information found

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: Not regulated

Hazard Class:

UN Number:

Packing Group:

Section 15 - Regulatory Information

US Federal**TSCA:**

CAS# 7732-18-5 is listed on the TSCA Inventory.

CAS# 1310-73-2 is listed on the TSCA Inventory.

CAS# 1303-96-4 is listed on the TSCA Inventory.

SARA Reportable Quantities (RQ):

CAS# 1310-73-2: final RQ = 1000 pounds (454 kg)

CERCLA/SARA Section 313:

None of the components are reportable under Section 313.

OSHA - Highly Hazardous:

None of the chemicals in this product are considered highly hazardous by OSHA.

US State**State Right to Know:**

Sodium hydroxide can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.



Material Safety Data Sheet

Buffer Solution pH 10.0

Sodium tetraborate, decahydrate can be found on the following state Right-to-Know lists:
California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California Regulations:

None.

European/International Regulations

Canadian DSL/NDSL:

CAS# 7732-18-5 is listed on Canada's DSL List.

CAS# 1310-73-2 is listed on Canada's DSL List.

CAS# 1303-96-4 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

CAS# 1310-73-2 is listed on Canada's Ingredient Disclosure List.

CAS# 1303-96-4 is listed on Canada's Ingredient Disclosure List.

Section 16 - Other Information

MSDS Creation Date: July 4, 1998

Revision Date: September 9, 2009

Information in this MSDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc. assumes no liability resulting from the use of this MSDS. The user must determine suitability of this information for his application.



Material Safety Data Sheet

Buffer Solutions pH 3.00, 4.00, and 5.00

Section 1 - Chemical Product and Company Identification

MSDS Name:

Buffer Solutions pH 3.00, 4.00, and 5.00

Catalog Numbers:

LC12250, LC12270, LC12280, LC12300

Synonyms:

Acid phthalate buffers, potassium biphthalate buffers, potassium dihydrogen phthalate buffers, neutralized phthalate buffers

Company Identification:

LabChem Inc
200 William Pitt Way
Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300 or
011-703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
7732-18-5	Water	balance
877-24-7	Potassium hydrogen phthalate	>1
50-00-0	Formaldehyde	0.04
7647-01-0	Hydrochloric acid	0-0.1
1310-73-2	Sodium hydroxide	0-0.1

Section 3 - Hazards Identification

Emergency Overview

Appearance: Clear, colorless solution (LC12280- clear, red solution)

Caution! May cause irritation to eyes, skin, respiratory and gastrointestinal tracts. May cause cancer. May cause adverse liver and kidney effects.

Target Organs: Liver, kidneys, eyes, skin, respiratory and gastrointestinal tract

Potential Health Effects

Eye:

May cause eye irritation.

Skin:

May cause skin irritation.



Material Safety Data Sheet

Buffer Solutions pH 3.00, 4.00, and 5.00

Ingestion:

Causes gastrointestinal irritation with nausea, vomiting and diarrhea.

Inhalation:

May cause respiratory tract irritation.

Chronic:

May cause dermatitis and conjunctivitis. May cause adverse liver and kidney effects. May cause cancer.

Section 4 - First Aid Measures

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids until no evidence of chemical remains. Get medical aid at once.

Skin:

Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid.

Ingestion:

Give conscious victim 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid at once.

Inhalation:

Move victim to fresh air immediately. If breathing is difficult, administer oxygen. Give artificial respiration if necessary. Get medical aid at once.

Notes to Physician:

Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Autoignition Temperature:

Not available

Flash Point:

Not applicable

NFPA Rating:

Health- 1, Flammability- 0, Instability- 0

Explosion Limits:

Lower: n/a Upper: n/a

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.



Material Safety Data Sheet

Buffer Solutions pH 3.00, 4.00, and 5.00

Spills/Leaks:

Absorb spill with inert material such as sand, vermiculite, or diatomaceous earth, and transfer to a suitable container labeled for later disposal.

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Do not ingest or inhale. Do not get in eyes, on skin, or on clothing.

Storage:

Store tightly capped in a cool, dry, well-ventilated area away from incompatible materials.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities using or storing this material should be equipped with an eyewash and safety shower. Provide local exhaust or general dilution ventilation to keep airborne levels below the permissible exposure limits.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Water	None listed	None listed	None listed
Potassium hydrogen phthalate	None listed	None listed	None listed
Formaldehyde	0.3 ppm Ceiling	0.016 ppm TWA 0.1 ppm Ceiling 20 ppm IDLH	0.75 ppm TWA 2 ppm STEL
Hydrochloric acid	2 ppm Ceiling	5 ppm Ceiling 50 ppm IDLH	5 ppm Ceiling
Sodium hydroxide	2 mg/m ³ Ceiling	10 mg/m ³ IDLH	2 mg/m ³ TWA

OSHA Vacated PELs:

Formaldehyde: 3 ppm TWA, 5 ppm Ceiling, 10 ppm STEL
Hydrochloric acid: 5 ppm Ceiling

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133. Do not wear contact lenses when working with chemicals.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29 CFR 1910.134. Always use a NIOSH-approved respirator when necessary.



Material Safety Data Sheet

Buffer Solutions pH 3.00, 4.00, and 5.00

Section 9 - Physical and Chemical Properties

Physical State:	Liquid
Color:	Colorless
Odor:	Odorless
pH:	3-5
Vapor Pressure:	Not available
Vapor Density:	Not available
Evaporation Rate:	Not available
Viscosity:	Not available
Boiling Point:	Not available
Freezing/Melting Point:	Not available
Decomposition Temperature:	Not available
Solubility in water:	Soluble
Specific Gravity/Density:	1.0
Molecular Formula:	Not available
Molecular Weight:	Not available

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, excess heat.

Incompatibilities with Other Materials:

Strong oxidizing agents, nitric acid, metals, aldehydes, reducing agents, nitro compounds, halogenated hydrocarbons.

Hazardous Decomposition Products:

Carbon monoxide, carbon dioxide, potassium and sodium oxides, potassium fume, hydrogen chloride gas

Hazardous Polymerization:

Has not been reported.

Section 11 - Toxicological Information

RTECS:

CAS# 7732-18-5: ZC0110000

CAS# 877-24-7: CZ4326000

CAS# 50-00-0: LP8925000

CAS# 7647-01-0: MW4025000.

CAS# 1310-73-2: WB4900000.

LD50/LC50:

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg

CAS# 877-24-7:

Oral, rat: LD50 = >3200 mg/kg

Skin, guinea pig: LD50 = >1 g/kg



Material Safety Data Sheet

Buffer Solutions pH 3.00, 4.00, and 5.00

CAS# 50-00-0:

Inhalation, rat: LC50 = 0.578 mg/L/4H

Oral, rat: LD50 = 500 mg/kg

CAS# 7647-01-0:

Inhalation, rat: LC50 = 3124 ppm/1H

Oral, rat: LD50 = 700 mg/kg

Skin, rabbit: LD50 = 5010 mg/kg

CAS# 1310-73-2:

Draize test, rabbit, eye: 1% Severe

Draize test, rabbit, skin: 500 mg/24H Severe

Carcinogenicity:

CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NTP, OSHA, or California Proposition 65.

CAS# 877-24-7: Not listed as a carcinogen by ACGIH, IARC, NTP, OSHA, or California Proposition 65.

CAS# 50-00-0: Listed as a carcinogen by ACGIH, IARC, NTP, OSHA, and California Proposition 65.

CAS# 7647-01-0: Not listed as a carcinogen by ACGIH, IARC, NTP, OSHA, or California Proposition 65.

CAS# 1310-73-2: Not listed as a carcinogen by ACGIH, IARC, NTP, OSHA, or California Proposition 65.

Epidemiology:

See actual entry in RTECS for complete information.

Teratogenicity:

Teratogenic effects have occurred in laboratory animals.

Reproductive:

Experiments have shown reproductive toxicity effects on laboratory animals.

Mutagenicity:

Mutagenic effects have occurred in microorganisms.

Neurotoxicity:

No information found.

Section 12 - Ecological Information

No information found.

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: Not regulated

Hazard Class:

UN Number:

Packing Group:



Material Safety Data Sheet

Buffer Solutions pH 3.00, 4.00, and 5.00

Section 15 - Regulatory Information

US Federal

TSCA:

CAS# 7732-18-5 is listed on the TSCA Inventory.
CAS# 877-24-7 is listed on the TSCA Inventory.
CAS# 50-00-0 is listed on the TSCA Inventory.
CAS# 7647-01-0 is listed on the TSCA Inventory.
CAS# 1310-73-2 is listed on the TSCA Inventory.

SARA Reportable Quantities (RQ):

CAS# 50-00-0: final RQ = 100 pounds (45.4 kg)
CAS# 7647-01-0: final RQ = 5000 pounds (2270 kg)
CAS# 1310-73-2: final RQ = 1000 pounds (454 kg)

CERCLA/SARA Section 313:

This material contains Hydrochloric acid (CAS# 7647-01-0, 0-0.1%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

OSHA - Highly Hazardous:

CAS# 50-00-0 is considered highly hazardous by OSHA.
CAS# 7647-01-0 is considered highly hazardous by OSHA.

US State

State Right to Know:

Formaldehyde can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
Hydrochloric acid can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
Sodium hydroxide can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California Regulations:

WARNING: Catalog numbers LC12250, LC12270, LC12280, and LC12300 contain formaldehyde, a chemical known to the state of California to cause cancer or birth defects or other reproductive harm.

European/International Regulations

Canadian DSL/NDSL:

CAS# 7732-18-5 is listed on Canada's DSL List.
CAS# 877-24-7 is listed on Canada's DSL List.
CAS# 50-00-0 is listed on Canada's DSL List.
CAS# 7647-01-0 is listed on Canada's DSL List.
CAS# 1310-73-2 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.
CAS# 877-24-7 is not listed on Canada's Ingredient Disclosure List.
CAS# 50-00-0 is listed on Canada's Ingredient Disclosure List.
CAS# 7647-01-0 is listed on Canada's Ingredient Disclosure List.
CAS# 1310-73-2 is listed on Canada's Ingredient Disclosure List.



Material Safety Data Sheet
Buffer Solutions pH 3.00, 4.00, and 5.00

Section 16 - Other Information

MSDS Creation Date: February 14, 1998

Revision Date: October 11, 2010

Information in this MSDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc. assumes no liability resulting from the use of this MSDS. The user must determine suitability of this information for his application.



Material Safety Data Sheet

Sodium Hydroxide Solutions, 2.7-50% w/w

Section 1 - Chemical Product and Company Identification

MSDS Name:

Sodium Hydroxide Solutions, 2.7-50% w/w

Catalog Numbers:

LC24040, LC24060, LC24070, LC24075, LC24078, LC24085, LC24090, LC24095, LC24100, LC24110, LC24115, LC24120, LC24140, LC24150, LC24350, LC24380, LC24400, LC24420, LC24430, LC24450, LC24455, LC24460, LC24500, LC24523, LC24525

Synonyms:

Caustic Soda, Soda Lye, Sodium Hydrate

Company Identification:

LabChem, Inc.
200 William Pitt Way
Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300 or
011-703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
7732-18-5	Water	>49
1310-73-2	Sodium hydroxide	2.7-50

Section 3 - Hazards Identification

Emergency Overview

Appearance: Clear, colorless solution

Danger! Corrosive. Causes burns by all exposure routes.

Target Organs: *Eyes, skin, respiratory tract*

Potential Health Effects

Eye:

Causes eye burns. May cause chemical conjunctivitis and corneal damage.

Skin:

Causes skin burns. May cause deep, penetrating ulcers of the skin. May cause skin rash (in milder cases) and cold, clammy skin with cyanosis or pale color.

Ingestion:

Causes gastrointestinal tract burns. Causes severe pain, nausea, vomiting, diarrhea, and shock. May cause perforation of the gastrointestinal tract.



Material Safety Data Sheet

Sodium Hydroxide Solutions, 2.7-50% w/w

Inhalation:

Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, chemical pneumonitis and pulmonary edema.

Chronic:

Prolonged or repeated skin contact may cause dermatitis and conjunctivitis.

Section 4 - First Aid Measures

Eyes:

Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids until no evidence of chemical remains. Get medical aid at once.

Skin:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid at once.

Ingestion:

Do not induce vomiting. Give conscious victim 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid at once.

Inhalation:

Move victim to fresh air immediately. If breathing is difficult, administer oxygen. Give artificial respiration if necessary, using a mechanical device such as a bag and mask or one-way valve. Get medical aid at once.

Notes to Physician:

Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Use water with caution and in flooding amounts. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated.

Extinguishing Media:

Do NOT get water inside containers. For small fires, use dry chemical, carbon dioxide, or water spray. For large fires, use dry chemical, carbon dioxide, alcohol-resistant foam, or water spray. Cool containers with flooding quantities of water until well after fire is out.

Autoignition Temperature:

Not applicable.

Flash Point:

Not applicable.

NFPA Rating:

Health- 3, Flammability- 0, Instability- 1

Explosion Limits:

Lower: No information Upper: No information



Material Safety Data Sheet

Sodium Hydroxide Solutions, 2.7-50% w/w

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spill with inert material such as sand, vermiculite, or diatomaceous earth, and transfer to a suitable container labeled for later disposal. Label reclaimed spill material as corrosive. Material may be carefully neutralized to pH 7 with citric acid.

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Do not ingest or inhale. Do not get in eyes, on skin, or on clothing. Use with adequate ventilation. Do not breathe spray or mist.

Storage:

Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from strong acids and metals.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Water	None of the components are on this list.	None of the components are on this list.	None of the components are on this list.
Sodium hydroxide	2 mg/m ³ Ceiling	10 mg/m ³ IDLH	2 mg/m ³ TWA

OSHA Vacated PELs:

None listed

Personal Protective Equipment**Eyes:**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133. Do not wear contact lenses when working with chemicals.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29 CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

Section 9 - Physical and Chemical Properties



Material Safety Data Sheet

Sodium Hydroxide Solutions, 2.7-50% w/w

Physical State: Liquid
Color: Clear
Odor: Not available.
pH: Alkaline
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility in water: Soluble
Specific Gravity/Density: 1.1-1.5
Molecular Formula: NaOH
Molecular Weight: 40.00

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, extreme temperatures.

Incompatibilities with Other Materials:

Metals, acids, aluminum, nitro compounds, zinc, tin, halogenated hydrocarbons, nitromethane, flammable liquids.

Hazardous Decomposition Products:

Toxic fumes of sodium oxide.

Hazardous Polymerization:

Has not been reported.

Section 11 - Toxicological Information

RTECS:

CAS# 7732-18-5: ZC0110000.

CAS# 1310-73-2: WB4900000.

LD50/LC50:

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg.

CAS# 1310-73-2:

Draize test, rabbit, eye: 400 ug Mild;

Draize test, rabbit, eye: 1% Severe;

Draize test, rabbit, eye: 50 ug/24H Severe;

Carcinogenicity:

CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

CAS# 1310-73-2: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

Epidemiology:

No information found.



Material Safety Data Sheet

Sodium Hydroxide Solutions, 2.7-50% w/w

Teratogenicity:

No information found.

Reproductive:

No information found.

Mutagenicity:

No information found.

Neurotoxicity:

No information found.

Section 12 - Ecological Information

No information found.

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: Sodium hydroxide solution

Hazard Class: 8

UN Number: UN1824

Packing Group: PG II

Section 15 - Regulatory Information

US Federal**TSCA:**

CAS# 7732-18-5 is listed on the TSCA Inventory.

CAS# 1310-73-2 is listed on the TSCA Inventory.

SARA Reportable Quantities (RQ):

CAS# 1310-73-2: final RQ = 1000 pounds (454 kg)

CERCLA/SARA Section 313:

None of the components are on this list.

OSHA - Highly Hazardous:

None of the components are on this list.

US State**State Right to Know:**

Sodium hydroxide can be found on the following state Right-to-Know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Regulations:

None.



Material Safety Data Sheet

Sodium Hydroxide Solutions, 2.7-50% w/w

European/International Regulations

Canadian DSL/NDSL:

CAS# 7732-18-5 is listed on Canada's DSL List.

CAS# 1310-73-2 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

CAS# 1310-73-2 is listed on Canada's Ingredient Disclosure List.

Section 16 - Other Information

MSDS Creation Date: July 6, 1998

Revision Date: January 20, 2012

Information in this MSDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc. assumes no liability resulting from the use of this MSDS. The user must determine suitability of this information for his application.

Material Safety Data Sheet

Sulfuric acid 90-98%

ACC# 22350

Section 1 - Chemical Product and Company Identification

MSDS Name: Sulfuric acid 90-98%

Catalog Numbers: AC124640000, AC124640010, AC124640011, AC124640025, AC124640026, AC124645000, AC124645001, AC133610000, AC133610011, AC133610025, AC133610026, AC133610051, AC302070000, AC302070010, AC302070011, AC302070025, AC302070026, AC388270000, AC424520000, AC424520026, AC424525001, 13361-0010, 42452-0025, 42452-5000, A298-212, A298N119, A300-212, A300-225LB, A300-500, A300-500LC, A300-612GAL, A300-700LB, A300C-212, A300C-212002, A300C-212003, A300C-212LC, A300C212004, A300C212005, A300C212006, A300C212007, A300C212008, A300C212009, A300C212010, A300J-500, A300P-500, A300S-212, A300S-212LC, A300S-500, A300SI-212, A468-1, A468-2, A468-250, A468-500, A484-212, A510-212, A510-500, A510SK-212, NC9008405, NC9825433, S71211SC, S71211SCMF, S79200, SA174-212, SA174-4, SA176-4, SA196-500

Synonyms: Hydrogen sulfate; Oil of vitriol; Vitriol brown oil; Mattling acid; Battery acid; Sulphuric acid; Electrolyte acid; Dihydrogen sulfate; Spirit of sulfur; Chamber acid.

Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100

Emergency Number: 201-796-7100

For CHEMTREC assistance, call: 800-424-9300

For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7664-93-9	Sulfuric acid	90-98	231-639-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear colorless to yellow liquid.

Danger! Causes eye and skin burns. Causes digestive and respiratory tract burns. May be fatal if mist inhaled. Strong inorganic acid mists containing sulfuric acid may cause cancer. Concentrated sulfuric acid reacts violently with water and many other substances under certain conditions. May cause lung damage. Hygroscopic (absorbs moisture from the air). Corrosive to metal.

Target Organs: Lungs, teeth, eyes, skin.

Potential Health Effects

Eye: Causes severe eye burns. May cause irreversible eye injury. May cause blindness. May cause permanent corneal opacification. The severity of injury depends on the concentration of the solution and the duration of exposure.

Skin: Causes skin burns. The severity of injury depends on the concentration of the solution and the duration of exposure.

Ingestion: May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns.

Inhalation: May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. Inhalation

may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Because its vapor pressure is negligible, it exists in the air only as a mist or spray. Exposure may impair lung function and cause mucostasis (reduced mucous clearance).

Chronic: Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis. Effects may be delayed. Workers chronically exposed to sulfuric acid mists may show various lesions of the skin, tracheobronchitis, stomatitis, conjunctivitis, or gastritis. Occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic to humans.

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical aid immediately.

Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.

Ingestion: If swallowed, do NOT induce vomiting. Get medical aid immediately. If victim is fully conscious, give a cupful of water. Never give anything by mouth to an unconscious person.

Inhalation: POISON material. If inhaled, get medical aid immediately. Remove victim to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician: Monitor arterial blood gases, chest x-ray, and pulmonary function tests if respiratory tract irritation or respiratory depression is evident. Treat dermal irritation or burns with standard topical therapy. Effects may be delayed. Do NOT use sodium bicarbonate in an attempt to neutralize the acid.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Contact with water can cause violent liberation of heat and splattering of the material. Contact with metals may evolve flammable hydrogen gas. Runoff from fire control or dilution water may cause pollution. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Strong dehydrating agent, which may cause ignition of finely divided materials on contact. Oxides of sulfur may be produced in fire.

Extinguishing Media: Use extinguishing media most appropriate for the surrounding fire. Do NOT get water inside containers. If water is used, care should be taken, since it can generate heat and cause splattering if applied directly to sulfuric acid.

Flash Point: Not applicable.

Autoignition Temperature: Not available.

Explosion Limits, Lower: Not available.

Upper: Not available.

NFPA Rating: (estimated) Health: 3; Flammability: 0; Instability: 2; Special Hazard: -W-

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Carefully scoop up and place into appropriate disposal container. Provide ventilation. Do not get water inside containers. Cover with dry earth, dry sand, or other non-combustible material followed with plastic sheet to minimize spreading and contact with water.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Do not allow water to get into the container because of violent reaction. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Discard contaminated shoes. Use only with adequate ventilation. Do not breathe spray or mist. Do not use with metal spatula or other metal items. Inform laundry personnel of contaminant's hazards.

Storage: Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not store near alkaline substances. Store protected from moisture. Ideally, sulfuric acid should be stored in isolation from all other chemicals in an approved acid or corrosives safety cabinet.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Use a corrosion-resistant ventilation system.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sulfuric acid	0.2 mg/m3 TWA (thoracic fraction)	1 mg/m3 TWA 15 mg/m3 IDLH	1 mg/m3 TWA

OSHA Vacated PELs: Sulfuric acid: 1 mg/m3 TWA

Personal Protective Equipment

Eyes: Wear chemical splash goggles and face shield.

Skin: Wear neoprene gloves, apron, and/or clothing. Viton gloves are recommended.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Liquid

Appearance: oily - clear colorless to yellow

Odor: odorless

pH: 0.3 (1N solution)

Vapor Pressure: < 0.001 mm Hg @ 20 deg C

Vapor Density: 3.38 (air=1)

Evaporation Rate: Slower than ether.

Viscosity: 21 mPas @ 25 C

Boiling Point: 290 - 338 deg C

Freezing/Melting Point: 10 deg C

Decomposition Temperature: 340 deg C

Solubility: Soluble with much heat

Specific Gravity/Density: 1.84

Molecular Formula: H₂SO₄

Molecular Weight: 98.07

Section 10 - Stability and Reactivity

Chemical Stability: Sulfuric acid reacts vigorously, violently or explosively with many organic and inorganic chemicals and with water.

Conditions to Avoid: Excess heat, exposure to moist air or water, Note: Use great caution in mixing with water

due to heat evolution that causes explosive spattering. Always add the acid to water, never the reverse..

Incompatibilities with Other Materials: Metals, oxidizing agents, reducing agents, bases, acrylonitrile, chlorates, finely powdered metals, nitrates, perchlorates, permanganates, epichlorohydrin, aniline, carbides, fulminates, picrates, organic materials, flammable liquids.

Hazardous Decomposition Products: Oxides of sulfur.

Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:

CAS# 7664-93-9: WS5600000

LD50/LC50:

CAS# 7664-93-9:

Draize test, rabbit, eye: 250 ug Severe;
Inhalation, mouse: LC50 = 320 mg/m³/2H;
Inhalation, mouse: LC50 = 320 mg/m³;
Inhalation, rat: LC50 = 510 mg/m³/2H;
Inhalation, rat: LC50 = 510 mg/m³;
Oral, rat: LD50 = 2140 mg/kg;

Carcinogenicity:

CAS# 7664-93-9:

- **ACGIH:** A2 - Suspected Human Carcinogen (contained in strong inorganic acid mists)
- **California:** carcinogen, initial date 3/14/03 (listed as Strong inorganic acid mists containing sulfuric acid).
- **NTP:** Known carcinogen (listed as Strong inorganic acid mists containing s).
- **IARC:** Group 1 carcinogen

Epidemiology: Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal cancer. This suggests a possible relationship between carcinogenesis and inhalation of sulfuric acid mist.

Teratogenicity: Sulfuric acid was not teratogenic in mice and rabbits, but was slightly embryotoxic in rabbits (a minor, rare skeletal variation). The animals were exposed to 5 and 20 mg/m³ for 7 hr/day throughout pregnancy. Slight maternal toxicity was present at the highest dose in both species.

Reproductive Effects: No information found

Mutagenicity: There are no mutagenicity studies specifically of sulfuric acid. However, there are established effects of reduced pH in mutagenicity testing, as would be caused by sulfuric acid. These effects are an artifact of low pH and are not necessarily due to biological effects of sulfuric acid itself.

Neurotoxicity: No information found

Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: 49 mg/L; 48Hr; TLm (tap water @ 20C)

Fish: Bluegill/Sunfish: 24.5 ppm; 48Hr; TLm (fresh water)

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	SULFURIC ACID	SULFURIC ACID
Hazard Class:	8	8
UN Number:	UN1830	UN1830
Packing Group:	II	II

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 7664-93-9 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 7664-93-9: 1000 lb final RQ; 454 kg final RQ

SARA Section 302 Extremely Hazardous Substances

CAS# 7664-93-9: 1000 lb TPQ

SARA Codes

CAS # 7664-93-9: immediate, delayed, reactive.

Section 313

This material contains Sulfuric acid (CAS# 7664-93-9, 90-98%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.

This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 7664-93-9 is listed as a Hazardous Substance under the CWA.

None of the chemicals in this product are listed as Priority Pollutants under the CWA.

None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 7664-93-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Sulfuric acid, listed as 'Strong inorganic acid mists contain', a chemical known to the state of California to cause cancer.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

C

Risk Phrases:

R 35 Causes severe burns.

Safety Phrases:

S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S 30 Never add water to this product.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 7664-93-9: 2

Canada - DSL/NDSL

CAS# 7664-93-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A, D1A, E.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 7664-93-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 4/22/1999

Revision #15 Date: 2/13/2008

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.



Material Safety Data Sheet Zinc Acetate Solutions

Section 1 - Chemical Product and Company Identification

MSDS Name:

Zinc Acetate Solutions

Catalog Numbers:

LC27080, LC27100

Synonyms:

None

Company Identification:

LabChem Inc
200 William Pitt Way
Pittsburgh, PA 15238

Company Phone Number:

(412) 826-5230

Emergency Phone Number:

(800) 424-9300

CHEMTREC Phone Number:

(800) 424-9300 or
(011) 703-527-3887

Section 2 – Composition, Information on Ingredients

CAS#	Chemical Name:	Percent
7732-18-5	Water	balance
5970-45-6	Zinc acetate, dihydrate	10-22

Section 3 - Hazards Identification

Emergency Overview

Appearance: Clear, colorless solution

Caution. May cause eye irritation.

Target Organs: Eyes.

Potential Health Effects

Eye:

May cause eye irritation.

Skin:

May cause skin irritation.

Ingestion:

May cause irritation of the digestive tract.

Inhalation:

May cause respiratory tract irritation.

Chronic:

Chronic exposure may cause kidney damage.



Material Safety Data Sheet Zinc Acetate Solutions

Section 4 - First Aid Measures

Eyes:

Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin:

Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid.

Ingestion:

Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid immediately.

Inhalation:

Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Autoignition Temperature:

No information found.

Flash Point:

No information found.

NFPA Rating:

CAS# 7732-18-5: Health- 0, Flammability- 0, Instability- 0.

CAS# 5970-45-6: Health- 2, Flammability- 1, Instability- 0.

Explosion Limits:

Lower: n/a Upper: n/a

Section 6 - Accidental Release Measures

General Information:

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Absorb spills with inert absorbent (vermiculite, sand, fuller's earth) and place in suitable containers labeled for later disposal.



Material Safety Data Sheet Zinc Acetate Solutions

Section 7 - Handling and Storage

Handling:

Wash thoroughly after handling. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale.

Storage:

Store capped at room temperature. Protect from heat and incompatibles.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls:

Facilities using or storing this material should be equipped with an eyewash and safety shower.

Provide local exhaust or general dilution ventilation.

Exposure Limits:

Chemical Name:	ACGIH	NIOSH	OSHA
Water	None of the components are on this list	None of the components are on this list	None of the components are on this list
Zinc acetate, dihydrate	None of the components are on this list	None of the components are on this list	None of the components are on this list

OSHA Vacated PELs:

None.

Personal Protective Equipment**Eyes:**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133. Do not wear contact lenses when working with chemicals.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29 CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State:	Clear liquid
Color:	Colorless
Odor:	Slight acetic
pH:	5-7
Vapor Pressure:	No information found.
Vapor Density:	No information found.
Evaporation Rate:	No information found.
Viscosity:	No information found.
Boiling Point:	No information found.
Freezing/Melting Point:	No information found.
Decomposition Temperature:	No information found.
Solubility in water:	Soluble



Material Safety Data Sheet Zinc Acetate Solutions

Specific Gravity/Density: 1.0 – 1.2
Molecular Formula: No information found.
Molecular Weight: No information found.

Section 10 - Stability and Reactivity

Chemical Stability:

Stable under normal temperatures and pressures.

Conditions to Avoid:

Incompatible materials, excess heat.

Incompatibilities with Other Materials:

Strong oxidizing agents.

Hazardous Decomposition Products:

Carbon monoxide, carbon dioxide, zinc oxides.

Hazardous Polymerization:

Has not been reported.

Section 11 - Toxicological Information

RTECS:

CAS# 7732-18-5: ZC0110000.

CAS# 5970-45-6: ZG8750000.

LD50/LC50:

CAS# 7732-18-5:

Oral, rat: LD50 = >90 mL/kg.

CAS# 5970-45-6:

Oral, mouse: LD50 = 287 mg/kg

Oral, rat: LD50 = 794 mg/kg.

Carcinogenicity:

CAS# 7732-18-5: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

CAS# 5970-45-6: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

Epidemiology:

No information found

Teratogenicity:

No information found

Reproductive:

No information found

Mutagenicity:

No information found

Neurotoxicity:

No information found

Section 12 - Ecological Information

No information found



Material Safety Data Sheet Zinc Acetate Solutions

Section 13 - Disposal Considerations

Dispose of in accordance with Federal, State, and local regulations.

Section 14 - Transport Information

US DOT

Shipping Name: Not regulated.

Hazard Class:

UN Number:

Packing Group:

Section 15 - Regulatory Information

US Federal

TSCA:

CAS# 7732-18-5 is listed on the TSCA Inventory.

CAS# 5970-45-6 is not on the TSCA Inventory; however, its anhydrous form is on the inventory and so this hydrate is exempt from TSCA Inventory requirements (40CFR270.3(u)(2)).

SARA Reportable Quantities (RQ):

Zinc Acetate, Anhydrous (CAS No. 557-34-6): 1000 lbs. (453.6 kg)

CERCLA/SARA Section 313:

This material contains Zinc acetate dihydrate (CAS# 5970-45-6, 10-22%), listed as Zinc compounds, which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

OSHA - Highly Hazardous:

None of the components are on this list.

US State

State Right to Know:

Zinc acetate, anhydrous, can be found on the following state Right-to-Know lists: California, New Jersey, Florida, Pennsylvania, Massachusetts.

California Regulations:

None.

European/International Regulations

Canadian DSL/NDL:

CAS# 7732-18-5 is listed on Canada's DSL List.

CAS# 5970-45-6 is listed on Canada's DSL List.

Canada Ingredient Disclosure List:

CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

CAS# 5970-45-6 is not listed on Canada's Ingredient Disclosure List.



Material Safety Data Sheet Zinc Acetate Solutions

Section 16 - Other Information

MSDS Creation Date: February 14, 1998

Revision Date: February 17, 2011

Information in this MSDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc. assumes no liability resulting from the use of this MSDS. The user must determine suitability of this information for his application.



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Arsenic (inorganic compounds, as As)

Synonyms & Trade Names Arsenic metal: Arsenia

Other synonyms vary depending upon the specific As compound. [Note: OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite and all inorganic compounds containing arsenic except ARSINE.]

CAS No. 7440-38-2 (metal)

RTECS No.
CG0525000 (metal)
(/niosh-
rtecs/CG802C8.html)

DOT ID & Guide 1558 152 (<http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=152>) (metal)
(<http://www.cdc.gov/Other/disclaimer.html>)
1562 152 (<http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=152>) (dust)
(<http://www.cdc.gov/Other/disclaimer.html>)

Formula As
(metal)

Conversion

IDLH Ca [5 mg/m³ (as As)]
See: 7440382 (/niosh/idlh/7440382.html)

Exposure Limits

NIOSH REL : Ca C 0.002 mg/m³ [15-minute] See Appendix A ([pncgappdx.html](#))
OSHA PEL : [1910.1018] TWA 0.010 mg/m³

Measurement Methods

NIOSH 7300 (/niosh/docs/2003-154/pdfs/7300.pdf), 7301 (/niosh/docs/2003-154/pdfs/7301.pdf), 7303 (/niosh/docs/2003-154/pdfs/7303.pdf), 7900 (/niosh/docs/2003-154/pdfs/7900.pdf), 9102 (/niosh/docs/2003-154/pdfs/9102.pdf);
OSHA ID105
(<http://www.osha.gov/dts/sltc/methods/inorganic/id105/id105.html>)
(<http://www.cdc.gov/Other/disclaimer.html>)
See: **NMAM** (/niosh/docs/2003-154/) or **OSHA Methods**
(<http://www.osha.gov/dts/sltc/methods/index.html>)
(<http://www.cdc.gov/Other/disclaimer.html>)

Physical Description Metal: Silver-gray or tin-white, brittle, odorless solid.

MW:
74.9

BP:
Sublimes

MLT:
1135°F
(Sublimes)

Sol:
Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr:
5.73
(metal)

Fl.P: NA

UEL: NA

LEL: NA

Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame.

Incompatibilities & Reactivities Strong oxidizers, bromine azide [Note: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.]

Exposure Routes inhalation, skin absorption, skin and/or eye contact, ingestion	
Symptoms Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen]	
Target Organs Liver, kidneys, skin, lungs, lymphatic system	
Cancer Site [lung & lymphatic cancer]	
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated/Daily Remove: When wet or contaminated Change: Daily Provide: Eyewash, Quick drench	First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
Respirator Recommendations (See Appendix E) (nengapdx.html) NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter. Click here (pgintrod.html#nrg) for information on selection of N, R, or P filters. Any appropriate escape-type, self-contained breathing apparatus Important additional information about respirator selection (pgintrod.html#mustread)	
See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0013 (/niosh/ipcsneng/neng0013.html) See MEDICAL TESTS: 0017 (/niosh/docs/2005-110/nmed0017.html)	

Page last reviewed: April 4, 2011

Page last updated: November 18, 2010

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Chromium metal					
Synonyms & Trade Names Chrome, Chromium					
CAS No. 7440-47-3		EINECS No. GB4200000 (/niosh-rtcs/GB401640.html)		DOT ID & Guide	
Formula Cr		Conversion		IDLH 250 mg/m ³ (as Cr) See: 7440473 (/niosh/idlh/7440473.html)	
Exposure Limits			Measurement Methods		
<p>NIOSH REL : TWA 0.5 mg/m³ See Appendix C (nengapdx.html)</p> <p>OSHA PEL *: TWA 1 mg/m³ See Appendix C (nengapdx.html) [*Note: The PEL also applies to insoluble chromium salts.]</p>			<p>NIOSH 7024 (/niosh/docs/2003-154/pdfs/7024.pdf), 7300 (/niosh/docs/2003-154/pdfs/7300.pdf), 7301 (/niosh/docs/2003-154/pdfs/7301.pdf), 7303 (/niosh/docs/2003-154/pdfs/7303.pdf), 9102 (/niosh/docs/2003-154/pdfs/9102.pdf);</p> <p>OSHA ID121 (http://www.osha.gov/dts/slc/methods/inorganic/id121/id121.html) (http://www.cdc.gov/Other/disclaimer.html), ID125G (http://www.osha.gov/dts/slc/methods/inorganic/id125g/id125g.html) (http://www.cdc.gov/Other/disclaimer.html)</p> <p>See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/slc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)</p>		
Physical Description Blue-white to steel-gray, lustrous, brittle, hard, odorless solid.					
MW: 52.0	BP: 4788°F	MLT: 3452°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 7.14	Fl.P: NA	UEL: NA	LRL: NA		
Noncombustible Solid in bulk form, but finely divided dust burns rapidly if heated in a flame.					
Incompatibilities & Reactivities Strong oxidizers (such as hydrogen peroxide), alkalis					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin; lung fibrosis (histologic)					
Target Organs Eyes, skin, respiratory system					

Personal Protection/Sanitation (See [protection codes \(protect.html\)](#))**Skin:** No recommendation**Eyes:** No recommendation**Wash skin:** No recommendation**Remove:** No recommendation**Change:** No recommendation**First Aid** (See [procedures \(firstaid.html\)](#))**Eye:** Irrigate immediately**Skin:** Soap wash**Breathing:** Respiratory support**Swallow:** Medical attention immediately**Respirator Recommendations****NIOSH****Up to 2.5 mg/m³:**

(APF = 5) Any quarter-mask respirator.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.***Up to 5 mg/m³:**

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.*

(APF = 10) Any supplied-air respirator*

Up to 12.5 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode*

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter.*

Up to 25 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter*

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 250 mg/m³:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](http://niosh/npg/pgintrod.html) See ICSC CARD: [0029 \(/niosh/ipcsneng/neng0029.html\)](http://niosh/ipcsneng/neng0029.html)

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Copper (dusts and mists, as Cu)					
Synonyms & Trade Names Copper metal dusts, Copper metal fumes					
CAS No. 7440-50-8	RTCS No. GL5325000 (/niosh-rtecs/GL5140C8.html)		DOT ID & Guide		
Formula Cu	Conversion		IDLH 100 mg/m³ (as Cu) See: 7440508 (/niosh/idlh/7440508.html)		
Exposure Limits NIOSH REL *: TWA 1 mg/m³ [*Note: The REL also applies to other copper compounds (as Cu) except Copper fume.] OSHA PEL *: TWA 1 mg/m³ [*Note: The PEL also applies to other copper compounds (as Cu) except copper fume.]			Measurement Methods NIOSH 7029 (/niosh/docs/2003-154/pdfs/7029.pdf), 7300 (/niosh/docs/2003-154/pdfs/7300.pdf), 7301 (/niosh/docs/2003-154/pdfs/7301.pdf), 7303 (/niosh/docs/2003-154/pdfs/7303.pdf), 9102 (/niosh/docs/2003-154/pdfs/9102.pdf); OSHA ID121 (/http://www.osha.gov/dts/slc/methods/inorganic/id121/id121.html), ID125G (/http://www.cdc.gov/Other/disclaimer.html), ID125G (/http://www.osha.gov/dts/slc/methods/inorganic/id125g/id125g.html), ID125G (/http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (/http://www.osha.gov/dts/slc/methods/index.html), (/http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Reddish, lustrous, malleable, odorless solid.					
MW: 63.5	BP: 4703°F	MLT: 1981°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 8.94	Fl.P: NA	URL: NA	LRL: NA		
Noncombustible Solid in bulk form, but powdered form may ignite.					
Incompatibilities & Reactivities Oxidizers, alkalis, sodium azide, acetylene					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis; in animals: lung, liver, kidney damage; anemia					
Target Organs Eyes, skin, respiratory system, liver, kidneys (increased risk with Wilson's disease)					

Personal Protection/Sanitation (See [protection codes \(protect.html\)](#))**Skin:** Prevent skin contact**Eyes:** Prevent eye contact**Wash skin:** When contaminated**Remove:** When wet or contaminated**Change:** Daily**First Aid** (See [procedures \(firstaid.html\)](#))**Eye:** Irrigate immediately**Skin:** Soap wash promptly**Breathing:** Respiratory support**Swallow:** Medical attention immediately**Respirator Recommendations****NIOSH/OSHA****Up to 5 mg/m³:**

(APF = 5) Any quarter-mask respirator.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.***Up to 10 mg/m³:**

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.*

(APF = 10) Any supplied-air respirator*

Up to 25 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode*

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter.*

Up to 50 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter*

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 100 mg/m³:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0240](#)([/niosh/ipcsneng/nengo240.html](#)) See MEDICAL TESTS: [0057 \(/niosh/docs/2005-110/nmed0057.html\)](#)

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Lead					
Synonyms & Trade Names Lead metal, Plumbum					
CAS No. 7439-92-1		RTECS No. OF7525000 (/niosh-rtcs/OF7525000.html)		DOT ID & Guide	
Formula Pb		Conversion		IDLH 100 mg/m³ (as Pb) See: 7439921 (/niosh/IDLH/7439921.html)	
Exposure Limits				Measurement Methods	
NIOSH REL *: TWA (8-hour) 0.050 mg/m³ See Appendix C (nengapdx.html) [*Note: The REL also applies to other lead compounds (as Pb) -- see Appendix C.] OSHA PEL *: [1910.1025] TWA 0.050 mg/m³ See Appendix C (nengapdx.html) [*Note: The PEL also applies to other lead compounds (as Pb) -- see Appendix C.]				NIOSH 7082 (/niosh/docs/2003-154/pdfs/7082.pdf) , 7105 (/niosh/docs/2003-154/pdfs/7105.pdf) , 7300 (/niosh/docs/2003-154/pdfs/7300.pdf) , 7301 (/niosh/docs/2003-154/pdfs/7301.pdf) , 7303 (/niosh/docs/2003-154/pdfs/7303.pdf) , 7700 (/niosh/docs/2003-154/pdfs/7700.pdf) , 7701 (/niosh/docs/2003-154/pdfs/7701.pdf) , 7702 (/niosh/docs/2003-154/pdfs/7702.pdf) , 9100 (/niosh/docs/2003-154/pdfs/9100.pdf) , 9102 (/niosh/docs/2003-154/pdfs/9102.pdf) , 9105 (/niosh/docs/2003-154/pdfs/9105.pdf) ; OSHA ID121 (http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html) (http://www.cdc.gov/Other/disclaimer.html) , ID125G (http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html) (http://www.cdc.gov/Other/disclaimer.html) , ID206 (http://www.osha.gov/dts/sltc/methods/inorganic/id206/id206.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)	
Physical Description A heavy, ductile, soft, gray solid.					
MW: 207.2	BP: 3164°F	MLT: 621°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 11.34	Fl.P: NA	UEL: NA	LEL: NA		
Noncombustible Solid in bulk form.					
Incompatibilities & Reactivities Strong oxidizers, hydrogen peroxide, acids					

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension

Target Organs Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue

Personal Protection/Sanitation (See [protection codes \(protect.html\)](#))
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: Daily
Remove: When wet or contaminated
Change: Daily

First Aid (See [procedures \(firstaid.html\)](#))
Eye: Irrigate immediately
Skin: Soap flush promptly
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations
 (See [Appendix E](#)) ([nengapdx.html](#))
NIOSH/OSHA

Up to 0.5 mg/m³:

(APF = 10) Any air-purifying respirator with an N100, R100, or P100 filter (including N100, R100, and P100 filtering facepieces) except quarter-mask respirators.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 10) Any supplied-air respirator

Up to 1.25 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter.

Up to 2.5 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 50 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Up to 100 mg/m³:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection ([pgintrod.html#mustread](#))

See also: **INTRODUCTION** ([/niosh/npg/pgintrod.html](#)) See ICSC CARD: **0052** ([/niosh/ipcsneng/neng0052.html](#)) See MEDICAL TESTS: **0127** ([/niosh/docs/2005-110/nmedo127.html](#))

Page last reviewed: April 4, 2011

Page last updated: November 18, 2010

Content source: **National Institute for Occupational Safety and Health (NIOSH)** Education and Information Division

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Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™

Search the Pocket Guide

Enter search terms separated by spaces.

Zinc oxide					
Synonyms & Trade Names Zinc peroxide					
CAS No. 1314-13-2		RTCS No. ZH4810000 (/niosh-rtecs/ZH496510.html)		DOT ID & Guide 1516 143 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=143) ⓘ (http://www.cdc.gov/Other/disclaimer.html)	
Formula ZnO		Conversion		IDLH 500 mg/m³ See: 1314132 (/niosh/idlh/1314132.html)	
Exposure Limits NIOSH REL : Dust: TWA 5 mg/m³ C 15 mg/m³ Fume: TWA 5 mg/m³ ST 10 mg/m³ OSHA PEL † (nengapdxg.html): TWA 5 mg/m³ (fume) TWA 15 mg/m³ (total dust) TWA 5 mg/m³ (resp dust)			Measurement Methods NIOSH 7303 ⓘ (/niosh/docs/2003-154/pdfs/7303.pdf), 7502 ⓘ (/niosh/docs/2003-154/pdfs/7502.pdf); OSHA ID121 (http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html) ⓘ (http://www.cdc.gov/Other/disclaimer.html), ID143 (http://www.osha.gov/dts/sltc/methods/inorganic/id143/id143.html) ⓘ (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) ⓘ (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description White, odorless solid.					
MW: 81.4	BP: ?	MLT: 3587°F	Sol(64°F): 0.0004%	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 5.61	Fl.P: NA	UEL: NA	LEL: NA		
Noncombustible Solid					
Incompatibilities & Reactivities Chlorinated rubber (at 419°F), water [Note: Slowly decomposed by water.]					
Exposure Routes inhalation					
Symptoms Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function					

Target Organs respiratory system**Personal Protection/Sanitation** (See [protection codes \(protect.html\)](#))**Skin:** No recommendation**Eyes:** No recommendation**Wash skin:** No recommendation**Remove:** No recommendation**Change:** No recommendation**First Aid** (See [procedures \(firstaid.html\)](#))**Breathing:** Respiratory support**Respirator Recommendations****NIOSH/OSHA****Up to 50 mg/m³:**

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 10) Any supplied-air respirator

Up to 125 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter.

Up to 250 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 500 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](http://niosh/npg/pgintrod.html) See ICSC CARD: [0208 \(/niosh/ipcsneng/nengo208.html\)](http://niosh/ipcsneng/nengo208.html) See MEDICAL TESTS: [0246 \(/niosh/docs/2005-110/nmedo246.html\)](http://niosh/docs/2005-110/nmedo246.html)

Page last reviewed: April 4, 2011

Page last updated: November 18, 2010

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APPENDIX B

HEALTH AND SAFETY FORMS



TAILGATE SAFETY MEETING

Project Name:	Date:
Project Number:	Time: Start: Stop:
Location:	Sheet: ____ of ____
Presented By:	
Topics Covered:	

I have reviewed the Site Health and Safety Plan for the _____ Site and understand the potential health and safety hazards at this operation and the emergency response procedures. I agree to conduct all on-site work in conformity with the requirements of the Health and Safety Plan.

NAME (print)	SIGNATURE	COMPANY
Safety and Health Concerns Expressed during Meeting:		
Corrective Actions Taken or Planned:		



REAL-TIME MONITORING INSTRUMENT CALIBRATION LOG

Project Name:		Project Number:
Location:		
Instrument (s):		
Model Number(s):		Serial Number(s):
Calibration Gas(es):	Concentration	

[illegible]



REAL-TIME MONITORING LOG

Date:		Person performing sampling:						
Project Name:		Signature:						
Project No.:								
Time	Monitoring Location (be specific)	READINGS						COMMENTS (Where was sample taken? e.g., breathing zone or other) and Duration of Monitoring
		O ₂ %	LEL %	VOC ppm	Dust mg/ m ³	Noise dB	Detect or Tube (spec. tube)	

Real Time Instrument Calibration Log should accompany this form.

INCIDENT AND INJURY REPORT

This form must be completed and forwarded to Corporate Health and Safety within 24 hours of any incident/injury.
For serious injuries, also complete page 2 and forward the entire form to Corporate Health and Safety by the end of the day.

Employer Name:	
Employer Address:	
Employer Phone #	Employers FAX #

EMPLOYEE		
Name:		Soc. Sec. #
Home Address:		
County:	Zip Code:	
Home Telephone:	Date of Birth:	Age:
Occupation: (Job Title):	Sex: Male <input type="checkbox"/> Female <input type="checkbox"/>	
Department:	Married: Yes <input type="checkbox"/> No <input type="checkbox"/>	
How long employed:	Years	Mo.
No. Children under 18 yrs.		

ACCIDENT/INJURY	
Project Name:	Project Number:
Address of Accident:	
County:	Zip Code:
Was accident on company property: Yes <input type="checkbox"/> No <input type="checkbox"/>	
Date and Time of Injury:	Date Reported:
What was Employee doing when injured? (Be specific – include tools, equipment, materials, or objects involved):	
How did the injury occur? (Describe the event that resulted in injury):	
Body Part injured and nature of injury (Be specific):	
Name of object or substance that directly injured the employee:	

MEDICAL	
First aid given by:	
Date of medical assistance:	Was accident fatal?
Name of medical provider:	
Address of medical provider:	
Diagnosis:	
If hospitalized, name and address of hospital:	
EMPLOYEE'S SIGNATURE:	Date:
PREPARER'S SIGNATURE:	Date:
SUPERVISOR'S SIGNATURE:	Date:
HEALTH & SAFETY SIGNATURE:	Date:

INCIDENT AND INJURY REPORT

ACCIDENT INVESTIGATION AND FOLLOW-UP	
Provide additional information on what the employee was doing and how the injury occurred:	
Witness names (also addresses and phone numbers if not company personnel):	
What did the employee do or fail to do that caused or contributed to the accident?	
What caused or influenced the unsafe act?	
What condition of tools, equipment or the jobsite caused or contributed to the accident?	
What caused or influenced the unsafe condition?	
What action has been taken or is planned to prevent recurrence?	
Person(s) responsible for completion of the action:	
Target date:	Actual completion date:
Completed by:	

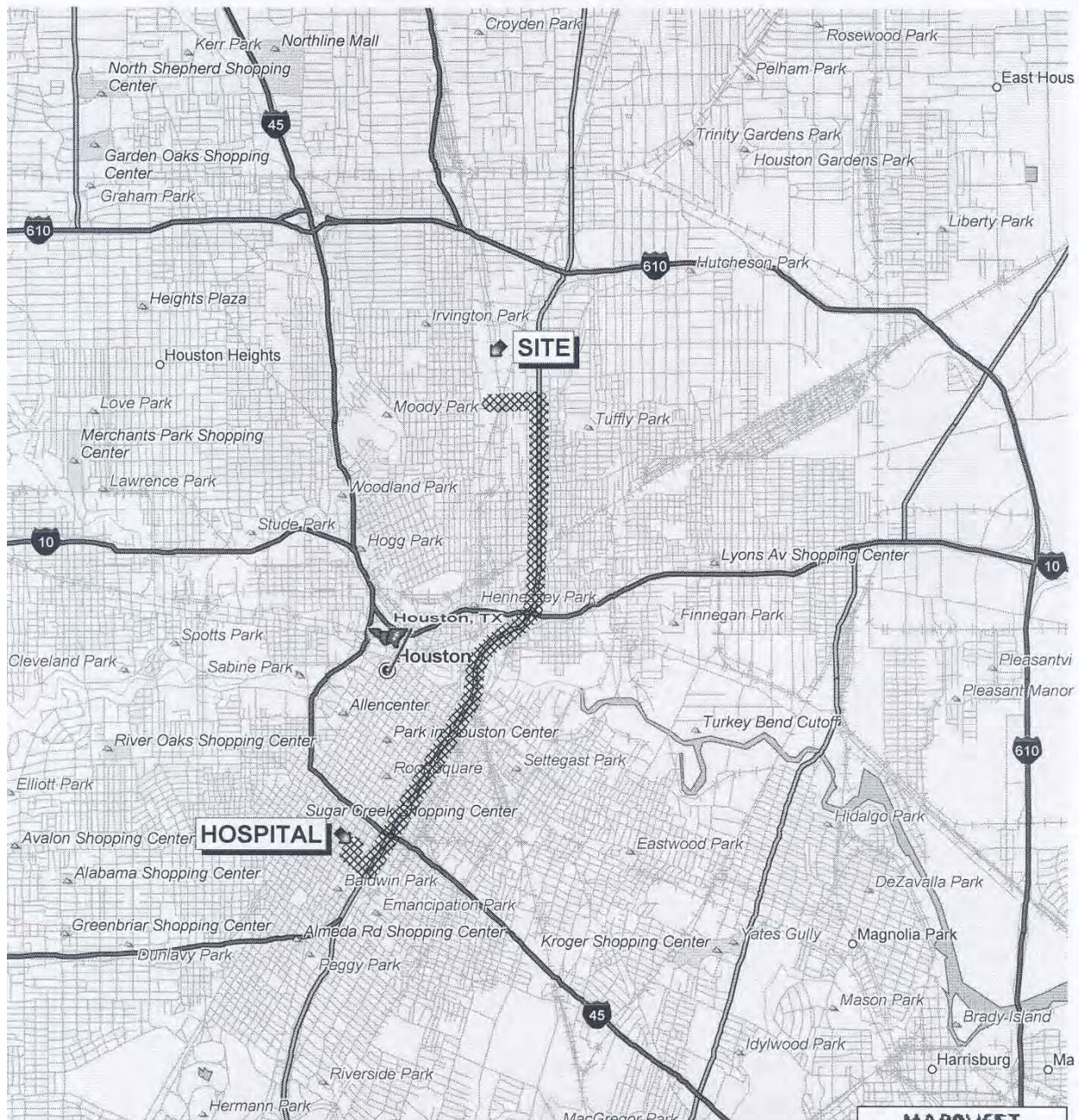
OFFICE USE ONLY	
Case Type: First Aid <input type="checkbox"/> Medical <input type="checkbox"/> Restricted <input type="checkbox"/> Days Away from Work <input type="checkbox"/>	
OSHA Recordable: Yes <input type="checkbox"/> No <input type="checkbox"/>	
Worker's Comp Claim Filed: Yes <input type="checkbox"/> No <input type="checkbox"/>	Date Filed:
Project Manager:	
Date lost work time began:	
Total days away from work:	
Date of restricted activity:	
Total restricted workdays:	
Date returned to full duty:	

APPENDIX C

**EMERGENCY CONTACTS AND
HOSPITAL ROUTE MAP**

EMERGENCY NUMBERS South Cavalcade Superfund Site Houston, Texas	
Fire	911
Police	911
Ambulance	911
Hospital – Christus St. Joseph Hospital	(713) 757-1000
John Francis – Key Environmental Inc. Health & Safety Manager	(412) 279-3363
National Response Center (spill, release reporting)	(800) 424-8802
DIRECTIONS TO EMERGENCY ROOM	
Christus St. Joseph Hospital – (713) 757-1000 1401 St. Joseph Parkway, Houston, TX 77002 Turn left (East) out of Site on Collingsworth St. about ½ mile to Eastex Freeway; Turn right (South) onto Eastex Freeway and merge onto US-59 (ramp in on the left); Travel south on the freeway for about 3.8 miles; Take the McGowen Ave./Taum Ave. exit then stay straight onto Hamilton St.; Turn right onto McGowen St. and go about 4 blocks; then, Turn right onto Crawford St. and then left into the hospital. Total estimated distance is about 5.5 miles. Total estimated time is about 10 minutes.	
UTILITY NUMBERS	
Houston One-Call Center	(800) 669-8344

HOSPITAL ROUTE MAP



Christus St. Joseph Hospital – (713) 757-1000 1401 St. Joseph Parkway, Houston, TX 77002

Turn left (East) out of Site on Collingsworth St. about ½ mile to Eastex Freeway;
 Turn right (South) onto Eastex Freeway and merge onto US-59 (ramp in on the left);
 Travel south on the freeway for about 3.8 miles;
 Take the McGowen Ave./Taum Ave. exit then stay straight onto Hamilton St.;
 Turn right onto McGowen St. and go about 4 blocks; then,
 Turn right onto Crawford St. and then left into the hospital.
 Total estimated distance is about 5.5 miles. Total estimated time is about 10 minutes.

ATTACHMENT B
FIELD INFORMATION FORMS



dmw-c:\msoffice\excel\GWSampleSheet Low Flow.xls
007027

BORING Field Investigation (2013) Spreadsheet - South Cavalcade, Houston, Texas

Boring Location	Drilling Complete Date	Total Depth	Sand/Silt - Intervals	Clay Intervals	*Core* Depth to Saturation	Impact Observations Product/Sheen/Odor/PID - and Interval	Plugged Yes/No	Temporary Monitor Well - Screen Interval -Depth	Groundwater Sample- Yes/No - Date	Temporary Monitoring Well Abandonment -Date	COMMENTS* Field Observations (e.g. turbidity)



LOG OF BORING: _____

Page ____ of ____

Client Name:	Drilling/Boring Method:	Total Boring Depth (ft):
Project Number:	Sampling Method:	Ground Surface Elev. (ft-msl):
Location:	Subcontractor/Drillers:	Measuring Point Elev. (ft-msl):
Date/Time Started:	Monitoring Equipment:	Geologist/Engineer:
Date/Time Completed:	Coordinates:	Consultant: KEY Environmental, Inc.

ft-bgs	Sample No.	PID (ppm)	Blows/in.	Recovery	SOIL DESCRIPTION (color, texture, moisture, etc.)	Lithology	USCS Classification	Well Construction	ft-bgs
0									0
1									1
2									2
3									3
4									4
5									5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14

Silt		Gravel	
Clay		Bedrock	
Sand			

NOTES
in - indicates inches
ft - indicates depth in feet
ft-bgs - indicates feet below ground surface
ft-msl - indicates feet above mean sea level
N/A - indicates not applicable to this boring
ppm - indicates parts per million

Signature of Field Supervisor

Date


LOG OF BORING: _____ (con't)

Page ____ of ____

ft-bgs	Sample No.	PID (ppm)	Blows/ft-in.	Recovery	SOIL DESCRIPTION (color, texture, moisture, etc.)	Lithology	USCS Classification	Well Construction	ft-bgs
14									14
15									15
16									16
17									17
18									18
19									19
20									20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30

NOTES

in - indicates inches
ft - indicates depth in feet
ft-bgs - indicates feet below ground surface
ft-msl - indicates feet above mean sea level
N/A - indicates not applicable to this boring
ppm - indicates parts per million



Legend:

Silt		Gravel	
Clay		Bedrock	
Sand			

LOG OF BORING: _____ (con't)

Page _____ of _____

ft-bgs	Sample No.	PID (ppm)	Blows/ft-in.	Recovery	SOIL DESCRIPTION (color, texture, moisture, etc.)	Lithology	USCS Classification	Well Construction	ft-bgs
30									30
31									31
32									32
33									33
34									34
35									35
36									36
37									37
38									38
39									39
40									40
41									41
42									42
43									43
44									44
45									45
46									46

Legend:

Silt: Gravel:

Clay: Bedrock:

Sand:

NOTES

in - indicates inches

ft - indicates depth in feet

ft-bgs - indicates feet below ground surface

ft-msl - indicates feet above mean sea level

N/A - indicates not applicable to this boring

ppm - indicates parts per million

LOG OF BORING: _____ (con't)

Page _____ of _____

ft-bgs	Sample No.	Hnu (ppm)	Blows/6-in	Recovery	SOIL DESCRIPTION (color, texture, moisture, etc.)	Lithology	USCS Classification	Well Construction	ft-bgs
46									46
47									47
48									48
49									49
50									50
51									51
52									52
53									53
54									54
55									55
56									56
57									57
58									58
59									59
60									60
61									61
62									62

NOTES

in - indicates inches
ft - indicates depth in feet
ft-bgs - indicates feet below ground surface
ft-msl - indicates feet above mean sea level
N/A - indicates not applicable to this boring
ppm - indicates parts per million

Silt

Clay

Sand

Gravel

Bedrock

ATTACHMENT C

LOW FLOW (MINIMAL DRAWDOWN)
GROUNDWATER SAMPLING
PROCEDURES – SOP 36

36 - LOW-FLOW (MINIMAL DRAWDOWN) GROUNDWATER SAMPLING PROCEDURES

1.0 SCOPE AND PURPOSE

This standard operating procedure (SOP) provides guidelines for the collection of representative groundwater samples from monitoring wells. Groundwater samples are typically collected from monitoring wells for laboratory analysis to support the characterization of representative groundwater quality. Low-flow purging has the advantages of minimizing the turbidity and mixing between the overlying stagnant casing water and water within the screened interval. Low-flow refers to the velocity with which water enters the pump intake from the formation pore water in the immediate vicinity of the well screen. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. Typically, flow rates on the order of 0.1-0.5 liter/minute are used, however, these flow rates may be varied dependent upon site-specific hydrogeology.

1.1 Referenced SOPs

03 – Field Logbook
22 – Sample Preparation
23 – Sample Handling, Preservation, Packaging and Shipping
24 – Chain of Custody
25 – Equipment Decontamination
26 – Depth to Groundwater and NAPL Measurements
34 – Groundwater Sampling

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

The following list identifies the types of equipment which may be used during groundwater sampling tasks. Project-specific equipment should be selected based upon project objectives, the depth of groundwater, purge volumes, analytical parameters, and well construction. The types of groundwater sampling equipment are as follows:

- Purging/Sample Collection Equipment
 - Low-flow (e.g., 0.1-0.5 liter/minute) pumps such as peristaltic pumps; bladder pumps, electrical submersible pumps, and gas-driven pumps
 - Pumps are to be constructed of stainless steel or Teflon®

Note that bailers are inappropriate devices for low-flow sampling.

Peristaltic pumps may be the least desirable choice, and for some projects, may not be an option at all. Some regions have specific requirements regarding what type of pumps should be used for sampling of particular analytical parameters. For example, USEPA Region II does not allow the use of peristaltic pumps for collecting samples for analysis of organic parameters. For this reason, region-specific requirements regarding pump selection shall be specified in the project-specific work plan. Another consideration is the soft silicon tubing required for use with the peristaltic pump mechanism. There is potential that this tubing may react with more complex organic compounds.

- Related sampling and field measurement equipment will include some or all of the following:
 - A multi-parameter measurement unit with in-line sampling capability such as a Horiba® U-10 or U-22
 - A photoionization detector (PID) to monitor for volatile organic constituents upon opening the monitoring well cap (the need for this instrument will be specified in the project specific work plan)
 - An in-line dissolved oxygen meter
 - An in-line turbidity meter
 - An in-line filtration apparatus, 0.45 micron, if dissolved metals are a constituent of interest at the site;
 - A water level meter
 - An interface probe, if light non-aqueous phase liquid (NAPL) or dense NAPL are potentially present on site (the need for this instrument will be specified in the project-specific work plan)
- General Equipment:
 - Safety Glasses or equivalent eye protection
 - Distilled water and dispenser bottle
 - Decontamination solutions (such as Alconox™ and solvents)
 - Field data sheets and log book
 - Sample preservation solutions
 - Sample containers
 - Buckets and intermediate containers
 - Coolers
 - Shipping labels
 - Permanent markers/pens
 - Packing tape
 - First aid kit
 - Key(s) for well locks
 - Stopwatch
- Disposable Materials:
 - Plastic sheeting/bags
 - Pump tubing
 - Gloves

- Filters
- Chemical-free paper towels
- Personal protective equipment, if necessary

3.0 METHODOLOGIES

3.1 Pre-Sampling Considerations

Water samples should not be collected immediately following well development. Sufficient time should be allowed for the groundwater flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and method of installation. New Jersey protocols require a minimum lag time of two weeks. USEPA protocols recommend an evaluation of site conditions with a typical minimum lag time of one week. (Note: Project personnel shall review applicable regulatory guidelines regarding the required lag time on a project-specific basis).

Several preparatory activities need to be completed prior to actual sampling of each well. These preparatory activities can be summarized as follows:

1. Log in sample bottles received from laboratory, prepare any deionized water or preservatives needed for the sampling;
2. If necessary, prepare pumps with standard decontamination procedures;
3. Don the necessary personnel protective equipment (PPE) stipulated in the Site health and safety plan (HASP);
4. Measure static water level prior to well purging. Water levels may be measured to the nearest hundredth of a foot with an electronic probe from the established measuring point of the well casing. If water levels will be used to determine groundwater flow direction and/or hydraulic gradients, all wells should be measured over as short a time period as possible. Water level measurements will be consistent with the procedures specified in *SOP 26 - Depth to Groundwater and NAPL Measurements*.
5. Unless specified otherwise in the project-specific work plan, well depth should be obtained from the well logs, rather than from measuring total depth, as this activity may disturb material that has settled to the bottom of the well and increase turbidity in samples. If it is necessary to measure total depth, or to measure dense non-aqueous phase liquid (DNAPL), perform these measurements after the sample has been collected.

3.2 Equipment Calibration

Prior to purging and sampling, all sampling devices and monitoring equipment should be calibrated according to manufacturer's recommendations, the site Quality Assurance Project Plan

(QAPP) and the project-specific work plan. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

3.3 **Well Purging**

For low-flow, minimal drawdown sampling protocols, an in-line water quality measurement device such as a flow-through cell is used to establish the stabilization time on a well-specific basis for several indicator parameters, as follows:

- pH
- Specific conductance
- Dissolved oxygen
- Turbidity
- Oxidation-Reduction Potential (ORP) (as required on a project-specific basis)

This differs from the general guideline used in conventional purging and sampling protocols that requires removal of a minimum of three casing volumes prior to sampling. Following are recommendations to be considered before, during, and after purging and sampling:

- Establish a flow rate that maintains minimal drawdown in the well during both purging and sampling
- Maximize tubing wall thickness and minimize tubing length
- Place the sampling device intake at the middle or slightly above the middle of the screened interval, unless specified otherwise in the project-specific work plan
- For wells completed as open boreholes in bedrock, placement of the sampling device will be specified in the project-specific work plan
- Minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion
- Make proper adjustments to stabilize the flow rate as soon as possible
- Monitor water quality indicators during purging

Pump Selection

There are no unusual requirements for groundwater sampling devices when using low-flow, minimal drawdown techniques. The primary requirement is that the device give consistent results and minimal disturbance of the sample across a range of low flow rates (i.e., <0.5 liter/minute). Note that pumping rates that cause minimal to no drawdown in one well could easily cause significant drawdown in another well that has been installed in a less transmissive formation. Consistency in operation is critical to meet accuracy and precision goals.

There are several pumps which are used frequently for purging or sampling. These types include the peristaltic, bladder, and submersible pumps. It is desirable that the pump be easily adjustable and operates reliably at these lower flow rates. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid. Bailers and other grab-type samplers are not suited for low-flow sampling and shall not be used.

Bladder Pumps

The bladder pump is a compressed air or gas-operated, positive displacement submersible well pump that uses inert compressed gas, e.g., nitrogen, to inflate an internal bladder which pumps water up the discharge line. These pumps are used when large volumes of water must be purged from monitoring wells or when water depths exceed the limits of a peristaltic pump. Usually these pumps are used on wells with diameters of 2 inches or greater and wells with depths up to 150 feet. When economically feasible the bladder pumps will be dedicated to each well. The line assembly is dedicated for use on one well only. After use, the tubing is wrapped, marked, and stored for future use in the well to which it is dedicated.

The following procedures should be followed for using the bladder pump:

1. Connect the line assembly to the pump by first attaching the cable and then connecting the sample and gas lines.
2. Lower the pump down the well by unrolling the line off the spool until the pump is located at the desired position inside the well.
3. Secure the cable to hold the pump at the desired depth.
4. Connect the gas line to the control box. The discharge line should be connected to the water quality meter or flow-through cell, with cell discharge line placed into a container (e.g., 5-gallon bucket or 55-gallon drum) to collect the purged water.
5. Connect the gas supply to the control box and adjust the pressure according to the manufacturer's manual.
6. As noted, the tubing is used on one well only; after each sampling event it is packed, sealed, and stored for future use on that well.

Submersible Pumps

When wells are encountered which require excessive lift (depth to water is greater than 20 feet) or have diameters greater than 2 inches, positive displacement submersible pumps may also be used to purge the required amount of water. When economically feasible, the submersible pumps will be dedicated to each well. However, in some cases, this is not economically feasible, and the same pump must be used in several wells. When this must be done, the pumps will be appropriately decontaminated between wells. Also, a pump will be used on wells known to contain similar constituent levels, or used first in wells with lower constituent levels before use in wells with historically higher constituent concentrations.

1. The submersible pump should be lowered to the desired depth using a safety line that is secured to the well casing.

2. Connect the power cord to the power source (generator) and turn on the pump.
3. Connect the discharge line to the water quality meter or flow-through cell, with cell discharge line placed into a container (e.g., 5-gallon bucket or 55-gallon drum) to collect the purged water.
4. Continue to monitor the pumping rate and water level in the well, slowing the rate if drawdown occurs.

Peristaltic Pumps

Peristaltic pumps must be operated above ground next to the well and are limited to water level depths of 20 to 30 feet below ground surface. The following procedure describes the use of peristaltic pumps for purging and sample collection.

1. New Nalgene[®] or low density polyethylene (LDPE) suction line is used on each well being purged. New silicone pump head tubing will also be used if the pump is also used for sampling.
2. The type of tubing used to collect the sample will be contingent on the parameters of interest.
 - If conventional parameters (i.e., biological oxygen demand [BOD], total suspended solids [TSS], fecal coliform, pH, and oil and grease) are being analyzed, then standard Nalgene[®] tubing is sufficient to collect the sample.
 - If volatile, semi-volatile, or metals parameters are the constituents of interest, Teflon[®] tubing is used to collect the sample.
3. All tubing is discarded after each use or packed, sealed and stored for future use within the same well.

Unless authorized otherwise, all purged groundwater is collected, containerized, and when possible, managed in an onsite treatment system.

3.4 Monitoring or Water Level and Water Quality Indicator Parameters

Performance criteria for determining stabilization should be based on water-level drawdown, pumping rate, and specifications for indicator parameters. Check the water level periodically during purging and sampling to monitor drawdown in the well as a guide to any necessary flow rate adjustment. The goal is minimal drawdown (<0.1 meter) during purging. This goal may not be possible to achieve under some circumstances and may require adjustment based on site-specific conditions and personal experience.

In-line water quality indicator parameters should be continuously monitored during purging as discussed in *SOP 34 – Groundwater Sampling*, as follows:

- Temperature
- pH
- ORP
- Specific conductivity
- Dissolved oxygen
- Turbidity

Measurements should be taken every three to five minutes. Stabilization is achieved after all parameters have stabilized for three successive readings. The three successive reading should be within the following guidelines to indicate stabilization:

- $\pm 10\%$ for temperature
- ± 0.2 SU for pH
- $\pm 3\%$ for conductivity
- ± 10 mv for ORP
- $\pm 10\%$ for turbidity
- $\pm 10\%$ for dissolved oxygen

Note that these are guidelines only; for example, in those instances where the field parameters measure at very low readings, even minor fluctuations can exceed the guidelines, even though stabilization has been achieved. In these instances, the field technician must use professional judgment to determine that parameter stabilization has been achieved.

Parameters will typically stabilize in the following order: pH, temperature, and specific conductance, followed by ORP, dissolved oxygen, and turbidity. If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization and is normally the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. Note that natural turbidity levels in groundwater may exceed 10 nephelometric units (NTU). Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well.

3.5 Groundwater Sampling

Once parameters have stabilized, begin sample collection as soon as possible. Disconnect or bypass the in-line monitoring device that was used to measure field parameters prior to sample collection. The sampling flow rate should remain at the established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates <0.5 liters/minute are appropriate. The same device used for purging should be used for sampling. Samples will be collected in decreasing order of their volatility. This order is generally as follows:

- Volatile organic chemicals (VOCs)
- Total organic halogens (TOX)
- Gas sensitive parameters (e.g., Fe^{2+} , CH_4 , $\text{H}_2\text{S}/\text{HS}^-$, alkalinity)
- Total organic carbon (TOC)
- Semivolatile organics chemicals (SVOCs)
- Inorganic parameters

If filtered samples are to be collected, these should be collected last

Samples collected for volatile organics should be carefully placed into 40 milliliter glass vials with Teflon[®] septum lids. No air bubbles should be present in the vial after sealing the septum lid; if air bubbles are present, fill the vial more completely. Other common laboratory-provided sample bottles include polyethylene or clear glass for metals and amber glass for phenols and SVOCs.

If the project-specific work plan or QAPP specifies dissolved metals analysis, field filtration of each sample will be necessary. Filtering is performed using an in-line filtration device, hand vacuum pumps with transfer vessels, or peristaltic pumps with disposable filters. If using the vacuum pump method, a laboratory cleaned transfer vessel is used. If using a peristaltic pump, new silicone tubing is used in the pump head for each sample filtered and new Teflon tubing is used from the pump head to the filter. Samples are filtered through 0.45 micron filter unless specified otherwise in the project-specific work plan. After filtering, samples requiring preservatives are preserved and all containers are securely placed in coolers and chilled to an appropriate temperature (usually $< 4^\circ\text{C}$). Each cooler containing samples will contain a completed chain-of-custody form.

Sampling technicians should wear a clean pair of disposable gloves for each well.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality control requirements depend upon project-specific circumstances and objectives and should be addressed in the QAPP or the project-specific work plan.

Quality assurance and quality control for groundwater sampling activities will consist of several distinct elements. Double checking of planned sample numbers versus numbers recorded on the field log sheets, on the sample label, and on the chain-of-custody form shall be completed to ensure that no mix up of samples versus locations occurs. Collection of field quality control samples will be completed as specified in the project planning documents and will typically consist of field duplicate samples, matrix-spike/matrix spike duplicates, and possibly rinsate blanks. Trip blanks and field blanks are typically not required, but may be required on a project-specific basis.

Decontamination of sampling equipment between sample locations is to be performed as outlined in *SOP 25 - Equipment Decontamination*. Sample preparation will follow *SOP 22 - Environmental Sample Preparation*. Sampling handling, preservation, packaging and shipping will follow *SOP 23 - Sample Handling, Preservation, Packaging and Shipping*. Chain of custody will be maintained at all times, following *SOP 24 - Chain of Custody*.

5.0 DOCUMENTATION AND RECORD KEEPING

A written record of each monitoring event must be maintained. The record provides a summary of the sample collection procedures and conditions, shipment method, the analyses requested and the custody history. This record consists of the following:

- Field logbook (*SOP 03 - Field Logbook*)
- Groundwater Sample Collection Forms (Attachment 1)
- Chain of custody forms (*SOP 24 - Chain of Custody*)
- Shipping receipts

Sample labels shall be completed at the time each sample is collected and will include the information listed below.


- Project name
- Sample number
- Time and date
- Preservative (if applicable)
- Analyses to be performed
- Sampler's name

6.0 REFERENCES

U.S. EPA, 1996, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures: Robert W. Puls and Michael J. Barcelona, EPA/540/S-95/504.

U.S. EPA Region II, Ground Water Sampling Procedure - Low Flow Pump Purging and Sampling.

ATTACHMENT 1
SOP 36 – LOW-FLOW (MINIMAL DRAWDOWN)
GROUNDWATER SAMPLING PROCEDURES
GROUNDWATER SAMPLE COLLECTION RECORD

						WELL NO.: _____	
GROUNDWATER SAMPLE COLLECTION RECORD							
Project No.: _____		Date: _____		Time: Start: _____		am/pm	
Project Name: _____				Finish: _____		am/pm	
Location: _____							
Weather Conditions _____				Collector: _____			
				Print		Sign	

1. WATER LEVEL DATA (measured from top of well casing)				Conversion Factors (cf) (c x cf = f)	
a. Total Casing Length: _____ (ft)	b. Well Casing Type: _____			Casing ID. (m)	Conv. Fact.
c. Depth to Water: _____ (ft)	d. Casing Diameter: _____ (in)			1	0.041
e. Length of Water Column: _____ (ft) (a-c)				2	0.163
f. Well Volume: _____ (gal)				3	0.367
				4	0.653
				6	1.470

2. WELL PURGE DATA							
a. Purge Method: _____							
b. Field Testing Equipment: _____							
c. Number of Well Volumes to Remove: _____							
d. Required Total Purge Volume (If x 2c): _____							

Vol. Purged (total gal)	Temp (°)	pH (s.u.)	Spec. Cond. ()	ORP (mV)	Diss. O ₂ (mg/L)	Turbidity (NTU)	

3. SAMPLE COLLECTION INFORMATION							
Sampling Method(s): _____							
Sample Identification (name, time, date): _____							
QC Samples (name, time, date): _____							
Analytical Parameters _____							
and Methods: _____							
Comments: _____							

ATTACHMENT D

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

SOUTH CAVALCADE SUPERFUND SITE HOUSTON, TEXAS

Prepared for:

Beazer East, Inc.

Prepared by:

**Key Environmental, Inc.
200 Third Avenue
Carnegie, Pennsylvania 15106**

MAY 2013

QUALITY ASSURANCE PROJECT PLAN

**SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS**

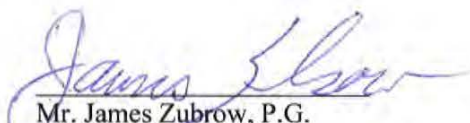
Prepared for:

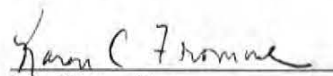
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B	LABORATORY QUALITY MANUAL

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LIST OF ABBREVIATIONS/ACRONYMS

%R	Percent Recovery
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
Beazer	Beazer East, Inc.
Bechtel	Bechtel Environmental, Inc.
C	Completeness
CLP	Contract Laboratory Program
COI	Constituent of Interest
Contractor	Key Environmental, Inc.
DNAPL	Dense Non-Aqueous Phase Liquid
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
GC	Gas Chromatograph
GDMVS	Graphical Data Management and Visualization System
GESPMP	Groundwater Extraction System Performance Monitoring Plan
GFTER	Groundwater Fate and Transport Evaluation Report
GIS	Geographic Information System
gpm	gallon per minute
GRAA	Groundwater Remedial Action Area
IDW	Investigation Derived Wastes
KEY	Key Environmental, Inc.
Koppers	Koppers Company, Inc.
LQM	Laboratory Quality Manual
MNA	Monitored Natural Attenuation
NPL	National Priorities List
PID	Photo-ionization Detector
QA/QC	Quality Assurance/Quality Control
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAWP	Remedial Action Work Plan
RD/RA	Remedial Design and Remedial Action
RDWP	Remedial Design Work Plan
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPD	Relative Percent Difference
SAS	Special Analytical Services
Site	South Cavalcade Superfund Site
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	Semi-volatile Organic Compound
TCL	Target Compound List
TCEQ	Texas Commission on Environmental Quality

TDWR	Texas Department of Water Resources
TOC	Total Organic Carbon
U.S. EPA	United States Environmental Protection Agency
VGFTER	Verification of Groundwater Fate and Transport Evaluation Report
VOC	Volatile Organic Compound
Workplan	Supplemental Groundwater Characterization Workplan

1.0 PROJECT MANAGEMENT

This Quality Assurance Project Plan (QAPP) has been prepared by Key Environmental, Inc. (KEY) on behalf of Beazer East, Inc. (Beazer) to support the Supplemental Groundwater Characterization Workplan (Workplan) for the South Cavalcade Superfund Site (Site) located in Houston Texas (Figure 1). This QAPP is intended to serve as an integral part of the Workplan. Please refer to the Workplan for a detailed description of the project objectives, scope of work and schedule. This QAPP provides details regarding the analytical methods, data analysis processes, and other procedures to be followed to ensure confidence in the analytical results and to document the validity of the results of the sampling and analysis activities described in the Workplan. Although this QAPP was prepared to support the Workplan, it is the intention of Beazer to update this document as necessary to support any future monitoring activities.

This QAPP satisfies United States Environmental Protection Agency (U.S EPA) requirements for a QAPP, in accordance with the following guidelines:

1. U.S. EPA, "Guidance for the Data Quality Objectives Process," EPA QA/G-4, August 2000;
2. U.S. EPA "EPA Requirements for Quality Assurance Project Plans," EPA QA/R-5, March 2001; and,
3. U.S. EPA "EPA Guidance for Quality Assurance Project Plans," EPA QA/G-5, December 2002.

1.1 PROJECT ORGANIZATION

Beazer will oversee and coordinate the project. KEY, as the Contractor, will be responsible for ensuring that project-specific sampling activities related to the supplemental groundwater characterization investigation are implemented in conformance with the requirements of the Workplan. Those tasks not performed by the Contractor will be completed by a subcontractor under the direct supervision of the Contractor. The Contractor will also perform Quality Assurance/Quality Control (QA/QC) functions for field activities and deliverables. Deliverables will be issued to Beazer by the Contractor for submittal to the U.S. EPA and the Texas Commission on Environmental Quality (TCEQ), as appropriate. The project organizational chart is presented in Figure 2. Test America Laboratories, Inc. (Test America) – Buffalo, located at 10 Hazelwood Dr #106, Amherst, NY, will be the subcontracted laboratory.

The management, technical, and QA/QC responsibilities of the key project personnel for implementation of the future sampling activities are summarized as follows:

- Beazer Project Manager
 - Coordinate project technical activities
 - Conduct project planning activities

- Attend review and planning meetings between Beazer, U.S EPA, and TCEQ, as necessary
- Review all project deliverables
- Oversee the project budget, schedule, and staffing
- Contractor Project Manager
 - Coordinate project technical activities
 - Assist the Beazer Project Coordinator in project planning
 - Attend review and planning meetings between Beazer, U.S EPA, and TCEQ, as necessary
 - Provide technical guidance to field personnel
 - Establish project files
 - Review all project deliverables
 - Manage the project budget, schedule, and staffing
- Contractor Investigation Task Leader
 - Organize and schedule field and laboratory subcontractor activities
 - Ensure that appropriate field documentation is incorporated into the project files
 - Supervise field investigation activities and ensure that the Workplan and QAPP are followed
 - Provide Health and Safety field support
 - Participate in project meetings with Beazer, U.S EPA, and TCEQ, as necessary
 - Prepare project technical reports
- Contractor QA/QC Officer
 - Review laboratory data corrective action, as necessary for quality assurance (QA) compliance
 - Perform or coordinate analytical data validation and review
 - Review laboratory QA/QC
 - Review data validation and review documentation
 - Initiate corrective action, as necessary, for QA compliance
- Laboratory Manager(s):
 - Ensure resources are available on an as-required basis
 - Coordinate analyses and chain of custody
 - Oversee review of data
 - Direct implementation of corrective actions required as a result of data review, internal audits, or external audits (if required)
 - Oversee preparation of analytical reports
 - Approve final analytical reports and case narratives prior to submission to the Contractor

- Analytical Laboratory QA/QC Officer:
 - Review laboratory QA and QC
 - Review QA/QC documentation
 - Investigate project-related nonconformance's
 - Verify resolution of such nonconformance's

Primary responsibility for data quality rests with the Contractor's QA/QC Officer. Ultimate responsibility for project data quality lies with the Contractor's Project Manager. Third level quality assurance will be provided by the analytical laboratory's Project Manager and QA/QC Officer prior to release of data and/or reports to the Contractor.

1.2 PROJECT BACKGROUND/ DEFINITION

Site background information is presented in this subsection; the Site description is discussed in Section 1.2.1 and the Site groundwater remedial history is presented in Section 1.2.2. The project definition is discussed in Section 1.2.3.

1.2.1 Site Description

The following site description is taken verbatim from the Verification of Groundwater Fate and Transport Evaluation Report (VGFTER) (KEY, 2000), except where noted at the end of this Subsection. The South Cavalcade Site occupies approximately 66 acres of urban land approximately three miles north of downtown Houston, Texas. The Site is rectangular in shape with a length of approximately 3,400 feet (in the north-south direction) and a width of approximately 900 feet (in the east-west direction). A Site plan is provided as Figure 3.

The Site was operated as a wood treating plant from 1910 until 1962. Creosote and various metal salts were used in the wood treating processes. The wood treating process area was located in the southern portion of the Site along Collingsworth Street. Koppers Company, Inc. (Koppers) operated the wood treating facility from 1940 until closure in 1962. A coal tar distillation plant was operated by Koppers on the southeastern portion of the Site from about 1944 until 1962. Since the discontinuation of these operations, several trucking firms have occupied the property.

The Site is currently occupied by three trucking firms; thus, much of the ground surface, especially in the southern and northern portions of the Site, is covered by concrete or asphalt pavement, or buildings, as shown on Figure 3. Additionally, Beazer completed the construction of a concrete cap in areas where soil concentrations exceed the remedial goal specified in the U.S. EPA Record of Decision (ROD) (U.S. EPA, 1998) for the Site. The central portion of the Site is currently undeveloped. A groundwater treatment facility is located along the eastern Site boundary in the central portion of the Site. Future use of the Site properties for non-residential purposes is to be expected, because deed restrictions for on-Site properties are in place and the consent agreements between U.S. EPA and the respective property owners prohibit property use for residential purposes. The consent agreements between EPA and the respective property owners also prohibit on-Site groundwater use.

Land use in the vicinity of the Site is a mixture of commercial, industrial and residential. Industrial and commercial properties are located to the east and across Collingsworth Street to the south of the Site. The North Cavalcade Superfund Site, which is also the location of a former wood treating facility, is located directly across Cavalcade Street to the north of the Site. Active rail lines immediately border the Site boundaries to the east and the west. The nearest residences are located several hundred feet to the west of the Site. Note that the Harris County Toll Road Authority (HCTRA) is constructing an extension of the Hardy Toll Road which will border the western Site boundary. As a result, the HCTRA has or is in the process of acquiring the railroad right-of-way and certain residential properties to the west of the Site.

1.2.2 Site Groundwater Remedial History

The following description of the Site groundwater remedial history is taken verbatim from the VGFTER except where noted at the end of this subsection. In 1983, the Houston Metropolitan Transit Authority investigated the Site for potential use in the municipal mass transit system. Results of this investigation indicated localized areas of potential impact and the Site was subsequently referred to the Texas Department of Water Resources (TDWR). In April 1984, TDWR recommended to U.S. EPA that the Site be placed on the National Priorities List (NPL). In October 1984, U.S. EPA proposed that the Site be added to the NPL. The Site was formally included on the NPL in June 1986.

In March 1985, Koppers entered into an Administrative Order on Consent (AOC) to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The RI/FS was completed by Koppers in August 1988, Remedial Investigation (Keystone Environmental Resources, July 1988) and Feasibility Study Reports (Keystone Environmental Resources, August 1988) were submitted to U.S. EPA.

A ROD was subsequently issued by U.S. EPA in September 1988 which presented the selected remedial alternatives for Site soil and groundwater. The selected remedial alternative for groundwater included extraction and treatment of groundwater containing constituent concentrations greater than the remedial goals specified in the ROD. The ROD stipulated that “groundwater collection will continue until constituents have been recovered to the maximum extent possible,” as “determined during the Remedial Action, based upon experience in operating the groundwater collection and treatment system.” The ROD specified that once U.S. EPA had determined that groundwater constituents have been recovered to the maximum extent possible, groundwater collection would cease and any remaining constituents would be allowed to naturally attenuate to background levels. The ROD also indicated that the groundwater could be remediated via in situ biological treatment if equal performance was demonstrated.

A Detailed Statement of Work for the South Cavalcade Site (SOW) was completed by Bechtel Environmental, Inc. (Bechtel) on behalf of Beazer in May 1990. The SOW described the remedial design and remedial action (RD/RA) activities to be performed by Beazer including pilot study tasks to support the design of the selected remedies. In March 1991, Beazer entered into a Consent Decree with U.S. EPA for implementation of the RD/RA activities specified in the SOW. The SOW was subsequently incorporated into the U.S. EPA-approved Remedial Design Work Plan (RDWP) prepared by Bechtel on behalf of Beazer, dated March 1992.

Tasks conducted to support the groundwater remedial design included groundwater collection well, groundwater recovery trench, and groundwater treatment system pilot studies. Pilot study tasks were completed in October 1993. A 100% Design Groundwater Collection and Reinjection System and Dense Non-Aqueous Phase Liquid (DNAPL) Recovery System Report was prepared by McLaren/Hart Environmental Engineering Corporation on behalf of Beazer. The design report was submitted to U.S. EPA in December 1994, and was subsequently approved.

Implementation of the groundwater remedial action was initiated in June 1995 in accordance with a U.S. EPA-approved Remedial Action Work Plan (RAWP) dated May 1995 and associated support documents. One DNAPL recovery well (RWN-4) and four groundwater collection wells (RWN-1, RWN-2, RWN-3 and RWN-5) were installed within Groundwater Remedial Action Area (GRAA) 1 located in the north section of the Site. One DNAPL recovery well (RWS-5) and three groundwater collection wells (RWS-3, RWS-4, and RWS-6) were installed within GRAA 2, which includes the area formerly occupied by the coal tar distillation plant. Two combined groundwater collection/DNAPL recovery wells (RWS-1 and RWS-2) were installed within GRAA 3, which includes the area formerly occupied by the wood treating process area.

Start-up of the groundwater collection and DNAPL recovery components of the groundwater remedy was conducted in September 1995, following completion of the groundwater treatment plant modifications. In an U.S. EPA letter dated October 6, 1995, U.S. EPA indicated that "there is some question as to whether U.S. EPA will continue to apply the current remedial action goals [i.e., the remedial goals specified in the ROD issued in 1988] to groundwater cleanup." This direction was taken in response to a July 31, 1995 U.S. EPA memorandum directing a policy favoring applicable and relevant and appropriate requirement (ARAR) waivers at sites where it is technically impracticable to remediate groundwater to Federal or State standards. As provided by the October 6, 1995 U.S. EPA letter and in accordance with an agreement between U.S. EPA and Beazer, groundwater collection and treatment has been delayed pending determination of the potential inapplicability of the groundwater remedial goals specified in the ROD. Operation of the DNAPL recovery component of the groundwater remedy is currently ongoing.

DNAPL recovery operations were conducted in conjunction with groundwater pumping during November and December 1995 as start-up of the groundwater treatment system was completed. In January 1996, operation of the DNAPL recovery system in the passive mode of operation (i.e. collection of DNAPL without groundwater pumping to increase hydraulic gradients) was initiated in accordance with the U.S. EPA-approved 100% Remedial Design. Evaluation of the DNAPL recovery data collected through June 1996 in accordance with the statistical protocol (i.e., zero-slope analysis) specified in the Groundwater Extraction System Performance Monitoring Plan (GESMPM) indicated that DNAPL had been recovered to the "maximum extent possible" under the passive mode of operation.

As a result and in accordance with the U.S. EPA-approved 100% Remedial Design, DNAPL recovery, with groundwater extraction to enhance hydraulic gradients, was initiated in one GRAA (GRAA 3) to evaluate the effectiveness and practicability of this enhancement prior to its use in the other GRAAs. Evaluation of the DNAPL recovery data collected in GRAA 3 from July through September 1996 indicated that groundwater extraction (at a pumping rate of 0.3 gallons per minute [gpm] from individual recovery wells) appeared to enhance DNAPL recovery

in Wells RWS-1 and RWS-2. Based on this observation, DNAPL recovery with groundwater extraction to enhance hydraulic gradients was initiated in GRAAs 1 and 2 in October 1996. Beazer continues operation of the DNAPL Recovery System in the gradient enhanced mode, in accordance with the U.S. EPA-approved RAWP and applicable U.S. EPA Guidance, such as the Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration.

In addition to the ongoing DNAPL recovery operation, Beazer has been conducting annual groundwater monitoring since March 1993 in two deeper monitoring wells located in the vicinity of the Site, as stipulated in the ROD. This activity is independent of the natural attenuation assessment for shallow groundwater and is subject only to the applicable provisions of the ROD and U.S. EPA approved RDWP. The results of this monitoring show that the deeper groundwater beneath the Site has not been impacted.

On August 5, 1997, Beazer submitted a revised Groundwater Fate and Transport Evaluation Report (GFTER) to the U.S. EPA for review and approval. The GFTER presented the results of analytical groundwater fate and transport modeling conducted using existing data, where possible, and information from published technical literature as protective default values where Site-specific data were not available. The fate and transport modeling presented in the GFTER was completed by Beazer as a preliminary evaluation of whether natural attenuation processes are sufficient to meet the remedial objectives for shallow groundwater at the South Cavalcade Site. The results of the GFTER supported a preliminary hypothesis that effective natural attenuation of dissolved organic constituents of interest (COI) may be occurring in the shallow groundwater zone at the Site. The GFTER was approved by the U.S. EPA on August 14, 1997.

On July 31, 2000, Beazer submitted a VGFTER to the U.S. EPA. The VGFTER was conducted pursuant to the Work Plan for Verification of the Groundwater Fate and Transport Evaluation which was reviewed and approved by the U.S. EPA. The VGFTER also describes and incorporates supplemental data collection activities that were conducted in response to the results from implementing the approved VGFTER Work Plan. The scope of the supplemental activities was communicated to U.S. EPA by letter dated March 21, 2000. The results of the VGFTER supported the conclusion that a Monitored Natural Attenuation (MNA) remedy is feasible for dissolved phase COIs in shallow groundwater at the South Cavalcade Site.

On March 1, 2006, Beazer submitted a Supplemental Site Characterization Report to the U.S. EPA. This investigation was conducted in accordance with the Supplemental Site Characterization Work Plan submitted and approved by EPA and TCEQ on August 17, 2005. Results indicate that significant constituent migration is not occurring with the targeted potential migration pathways in the shallow and intermediate zone.

From 2006 through 2011, Beazer completed a number of studies related to the applicability of the groundwater remedy specified in the ROD. These studies included a Focused Feasibility Study and FFS Addendum; Technical Impracticability Demonstration Report and a Technical Memorandum on the Evaluation of Natural Attenuation at the Site. The conclusions of these related studies were:

- Natural attenuation is occurring and the groundwater plumes are stable and receding;
- Continued efforts to remove DNAPL from the Site will not result in a significant reduction in risk; and,
- A TI Waiver of groundwater remedial goals is appropriate.

In March of 2011, Beazer conducted a site-wide round of groundwater sampling and analysis. The results of this sampling event showed that the extent and concentrations of constituents in groundwater have not increased. In addition, the following observations were made:

- With the exception of one piezometer (PZS-20), no DNAPL was observed to have accumulated (beyond traces) in any of the wells which is consistent with prior observations that very little recoverable DNAPL exists at the Site; and,
- Concentrations of constituents of interest are generally declining; the north and south plumes appear to be stable or decreasing in size and concentration.

On December 19, 2012, Beazer submitted a Soil Investigation Report to the U.S. EPA. The soil investigation was conducted in support of ongoing discussions with the U.S. EPA and TCEQ regarding an appropriate groundwater remedy for the Site. As part of these discussions, multiple supporting technical documents were submitted: a Technical Impracticability Demonstration Report (March 2001), a Natural Attenuation Evaluation Technical Memorandum (March 2001), and a Focused Feasibility Study (April 2011). These documents were reviewed by the agencies, and in response to comments, additional screening of technologies was completed as documented in a Draft Source Control (DNAPL) Technology Screening Summary (August 2011). A meeting and Site visit with the EPA and TCEQ was subsequently held on December 14, 2011. As a result of the Site visit EPA determined that a TI Waiver and MNA remedy was appropriate for the southern section of the Site but requested that an addendum to the Focused Feasibility Study to evaluate two additional technologies be prepared for the Northern Area. A Draft Focused Feasibility Study Addendum which evaluated two in situ treatment technologies was subsequently submitted (April 2012). Pursuant to review of the addendum, the EPA requested that additional study of the Northern Area be completed via a boring program to determine if sufficient source mass was present that would warrant implementation of an active remedy. Additional objectives of the soil boring program were to verify the nomenclature used during previous Site investigations to describe visual observations of potential impacts in soil and to refine the understanding of the occurrence and distribution of DNAPL in the northern part of the Site.

The soil investigation was conducted in accordance with a September 14, 2012 work plan submitted by Key Environmental, Inc. (KEY) on behalf of Beazer to the EPA and the TCEQ. By email from EPA dated September 17, 2012, EPA indicated that TCEQ and EPA were in agreement with the scope of work presented in the September 14, 2012 Work Plan.

The results of the soil investigation indicate that free phase DNAPL in the northern area was only observed in the vicinity of well RWN-4 where DNAPL has been recovered in the past and in two borings at the eastern border of the property. Without exception, DNAPL, where present

in these areas, was observed in discreet and dispersed thin lenses and streaks within the coarser grained non-cohesive sediments. No evidence of pooled DNAPL was observed. The data obtained from this investigation indicate that no areas exist where targeted treatment would provide commensurate benefit. Hence, the conclusions of the Focused Feasibility Study and Focused Feasibility Study Addendum remain valid.

1.2.3 Project Definition

The Work Plan, which this QAPP supports, presents the scope of work to support the definition of the limits of the TI Zones at the Site. The data acquired through implementation of this workplan will also be used in support of the preparation of the Proposed Plan and ROD Amendment, and in the development of a proposed future groundwater monitoring program. The approach to attaining the stated objectives involve the development of a comprehensive “snapshot” of the current nature and extent of COIs in groundwater. The snapshot of current conditions will be obtained through the installation and sampling of several temporary monitoring wells, located predominantly along inferred preliminary TI Zone boundaries, concurrent with the sampling of existing monitoring wells and piezometers. This QAPP is intended to serve as an integral part of the Work Plan. Please refer to the Work Plan for a detailed description of the project objectives, scope of work and schedule.

The scope of the investigation proposed herein was developed through collaborative efforts of representatives of Beazer, EPA, and TCEQ. The development of the scope of the investigation was initiated during the aforementioned April 9, 2013 meeting and was finalized during two subsequent conference calls among the parties on April 10, 2013 and April 19, 2013. During the April 19, 2013 conference call, EPA requested that Beazer prepare a brief workplan describing the scope of the investigation and the methodologies to be utilized for its implementation. This workplan was prepared in response to the EPA request. The specific objectives of the planned site characterization activities are outlined in the subsection 1.4.

1.3 PROJECT DESCRIPTION

The Workplan describes the investigation procedures necessary for additional delineation of the horizontal and vertical extent of constituents of interest (COI) in the shallow and intermediate groundwater-bearing zones at the South Cavalcade Superfund Site located in Houston Texas (Figure 1). Section 2.0 of the Workplan describes the scope of the TI Zone delineation investigation, the methodologies to be used for its implementation, and the chemical parameters that will be evaluated, in detail. Table 1 of this QAPP summarizes the sampling methods and parameters to be analyzed during each investigative task outlined in Section 2.0 of the Workplan. Table 2 of this QAPP presents the matrix sample summary, QC sample summary, and analytical requirements summary for each investigative task.

1.4 DATA QUALITY OBJECTIVE PROCESS

The Data Quality Objective (DQO) process specifies the appropriate amount and type of data required, and establishes tolerable levels of uncertainty for the environmental decisions to be made. U.S. EPA has developed a systematic process for developing DQOs that includes

consideration of several critical elements. The process requires definition of the problem and statement of the decisions that will be made based on study results. The users of the data and key personnel and their roles in the program are identified, as are any regulatory criteria or agencies that will be involved. Information needed to support these decisions can then be determined, including what the COIs are and physical boundaries of the study area, the quantity of data that will be needed, the means to collect these data and the level of uncertainty that will be acceptable. Program design can then be optimized to collect defensible data in the most efficient manner.

For the investigation described in the Workplan, the project objectives are as follows:

- To provide additional and current data to support the definition of the limits of the TI Zones;
- To provide data to support the preparation of the Proposed Plan and ROD Amendment; and,
- To provide data to support the development of a proposed future groundwater monitoring program.

1.4.1 Project Quality Objectives

This QAPP serves as a controlling mechanism during the supplemental groundwater characterization investigation to provide procedures which, when followed properly, will assure that all decisions based on laboratory and field data generated during this investigation are technically sound and properly documented. Specific procedures for sampling, laboratory analyses, data reporting, and data validation, are presented in other sections of this QAPP.

1.4.2 Measurement Performance Criteria

As a result of the varying nature of the data required, there are several applicable levels of data quality for the Workplan. A primary component of data quality is selection of the appropriate analytical level for the intended data use. Analytical levels, as described in “Data Quality Objectives for Remedial Response Activities” (U.S. EPA, March 1987), are as follows:

- Level I - Field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative, but are available in real-time. Level I data are appropriate for initial field screening and for health and safety monitoring. They are frequently used to determine sample collection locations for laboratory analyses.
- Level II - Field analysis using more sophisticated portable analytical instruments; in some cases, the instruments may be set up in a mobile laboratory on location. There is a wide range in the quality of data that can be generated that is dependent on the use of suitable calibration standards, reference materials and sample preparation equipment. Results are available in real-time or within several hours.

- Level III - All analyses are performed in an off-site analytical laboratory. Level III provides quantitative data. Documented sampling and analysis procedures must be used. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures, but at a minimum, abbreviated CLP-type deliverables are required. Level III requires QA/QC procedures conducted in accordance with U.S. EPA guidelines. The laboratory may or may not be a CLP laboratory.
- Level IV – CLP-equivalent routine analytical services. All analyses are performed in an off-site analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation with full validation of all data.
- Level V - Analysis by nonstandard methods. All analyses are performed in an off-site laboratory that may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP Special Analytical Services (SAS) are Level V.

Level I will be used for the screening activities required for the Workplan, specifically this includes screening data for volatile organic compounds (VOCs) measured with a photo-ionization detector (PID) and field water quality parameters (e.g. pH, conductivity, dissolved oxygen, and temperature). It is anticipated that all laboratory analytical services for the scope of work presented in the Workplan will be Level III.

Each of these levels is characterized by statistically based criteria expressed in terms of:

- Precision;
- Accuracy;
- Representativeness;
- Completeness;
- Comparability; and,
- Sensitivity.

These parameters are discussed in the following six subsections.

1.4.2.1 Precision

Precision is defined as the degree of agreement between repeated measurements of the same parameter under prescribed, similar conditions. Field and laboratory precision will be monitored using results from duplicate sample analyses. Precision can then be expressed as the relative percent difference (RPD) of one result with another. The RPD is calculated as follows:

$$RPD = \frac{D1 - D2}{\frac{(D1 + D2)}{2}} \times 100$$

Where: RPD = relative percent difference
D1 = first duplicate value
D2 = second duplicate value.

The overall DQO for precision of analytical measurements is expressed as a percent of the duplicates having RPDs within established control limits. For the purposes of this project, a RPD of 30% will be used as a benchmark. However, it should be recognized that significant variability in duplicate sample concentrations can occur. Groundwater samples that have the potential for significant interferences or high suspended solids content (e.g. those from temporary wells without sandpacks) may have significant variability in duplicate sample results. When evaluating the RPD results for field duplicate samples, the nature of the samples must be considered and professional judgment must be employed.

The precision of Level I data will be confirmed through repetitive and/or consecutive measurements. The precision of Level III data can be measured through the analysis of field duplicates, laboratory duplicates, and matrix spike duplicates. The frequency of field duplicate collection is specified in Section 2.5.1.1. The frequencies of laboratory duplicate analyses (required for inorganic analyses) and matrix spike/matrix spike duplicate set analyses (required for organic analyses), will be at a minimum of 1 per 20 field samples.

Reproducibility is expressed as a relative percent difference, which is the absolute value of the range between the duplicate results divided by the mean. Acceptable RPDs for each analyte from laboratory and matrix spike duplicates are specified in descriptions of their respective methods. Field duplicate precision criteria for waters are included in data validation guidelines.

1.4.2.2 Accuracy

Accuracy is the measure of the degree of agreement between an analyzed value and the true or accepted value where it is known. Field and laboratory accuracy will be monitored using known concentrations of analytes and surrogates spiked into blanks and selected samples. Accuracy can then be expressed as a percent recovery (%R), which is calculated as follows:

$$\%R = \frac{Qd}{Qa} \times 100$$

Where: %R = percent recovery
Qd = spiked sample result minus the sample result
Qa = spiked amount.

The overall DQO for accuracy is thus the percent of samples that have %R within prescribed control limits.

Accuracy of Level III data can be measured by the analysis of equipment blanks, trip blanks, method blanks, matrix spikes, and surrogate standards. Matrix spikes are samples to which known amounts of target constituents are added. Blanks provide a way of detecting biases introduced in the sampling, sample handling, and analysis.

The frequency of equipment blank and trip blank collection and analysis is specified in Section 2.5.1.1. The frequencies of analyses of method blanks, laboratory control spikes, and matrix spikes, and surrogate standards are specified in the respective methods. The methods also present the acceptable percent recovery limits for each analyte.

1.4.2.3 Representativeness

Representativeness expresses the extent to which the analytical data reflect the actual media at the site and are representative of site conditions and characteristics. Representativeness is a function of the sampling program design and execution and the analytical program. Representativeness from field activities is addressed by collecting an adequate number of samples from optimal locations using standard procedures. The number and location of samples and methodologies of sampling are specified in the Workplan. Representativeness as a function of analytical-method issues may be compromised by method deviations, the presence of potential laboratory or field artifacts, indications of sample non-homogeneity, and recovery anomalies from surrogates or spikes into field samples.

1.4.2.4 Completeness

Completeness (C) is a measure of the amount of valid data obtained from an analytical measurement system. It is expressed as a percent of the overall data that were generated and is calculated as follows:

$$\%C = \frac{V}{T} \times 100$$

Where: %C = percent completeness
V = number of measurements judged valid
T = total number of measurements.

An acceptable percentage of data determined to be valid should be established as target goals for each particular objective. Anything below these goals would require re-sampling and re-analysis or a modification to the goal with justification. As a general rule, the sampling programs will be designed so that program needs will be met if 90% completeness is achieved.

1.4.2.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared against another. Comparability is a qualitative function of the sampling and analysis methods. To assure that one data set can be compared to another, the sampling and analysis methods will follow well-documented standard procedures. The procedures to be used are described in the Workplan.

1.4.2.6 Sensitivity

Sensitivity is the ability of the method to detect the contaminant of concern at the concentration of interest (regulatory clean up standard). Method detection limits and reporting limits for the analytes of interest are specified in Section 2.4 and are adequately sensitive for the measurement of the constituents at the levels required for this project. QC measures which aid in evaluating sensitivity are field rinsate blanks, trip blanks, and laboratory method blanks. These QC samples are used to ensure that field or laboratory practices do not introduce contaminants, which may positively bias laboratory results. Method reporting limits are set at a level equal to that of the low level standard of the instrument calibration curve.

1.5 DOCUMENTATION AND RECORDS

All records generated during this project will be kept on file by Contractor on behalf of Beazer. These records may include: field log books, field sampling forms, chain of custody forms, laboratory data deliverables, photographs, and other relevant records. These records will be kept in accordance with applicable record retention requirements specified in the Consent Decree.

Revisions and updates to this QAPP will be prepared as Beazer and/or the Contractor deem necessary. A full revision to the QAPP will be prepared if work has not been completed within five years. This will ensure that laboratory changes or method improvements are addressed and that changes to program objectives or scope that may be made as a result of the information gathered in the initial stages are incorporated into the overall program QA/QC. Changes to the QAPP will be documented and signed by Beazer and the Contractor. Document control will be maintained through changing the Revision Numbers and Date in the header of this document.

2.0 MEASUREMENT DATA ACQUISITION

2.1 SAMPLING PROCESS DESIGN

Sampling methods/frequency, laboratory analytical methods/parameters, and QA/QC procedures/frequency are presented in this QAPP. Sampling locations, sampling methods, and sampling frequency are discussed in detail in Section 2.0 of the Workplan. Laboratory analytical parameters for the anticipated sampling and analysis programs will include analysis for the following parameters:

- Target Compound List (TCL) VOCs
- TCL SVOCs
- Total and Dissolved Metals (arsenic, chromium, copper, lead, zinc)

The specific list of parameters associated with each group of monitoring wells is identified on Table 1. Routine analyses will be performed in accordance with laboratory SOPs.

QA/QC samples will be collected and submitted to the laboratory for analysis in accordance with the frequencies discussed in Section 2.5.1.1 of this QAPP.

2.2 SAMPLING METHODS

Sections 2.0 and 3.0 of the Workplan provide detailed information regarding sampling methods, decontamination procedures, and management of investigation derived waste (IDW). Attachment C of the Workplan contains the Standard Operating Procedure (SOP) for low flow purging and sampling.

2.3 SAMPLING HANDLING AND CUSTODY

Included in Appendix A of this QAPP are KEY (SOPs) 03, 22, 23, and 24 which present the sample handling and custody procedures. Section 2.0 of the Workplan also discusses sample handling and custody information.

2.4 ANALYTICAL METHODS AND DETECTION LIMITS

The analytical procedures to be used for this program are presented in Table 2. Detailed information and quality control requirements are provided in the subcontract laboratory's Laboratory Quality Manual (LQM). The subcontract laboratory selected for this QAPP is Test America – Buffalo. The Texas lab certification number for Test America - Buffalo is T104704412-12-3. A copy of Test America - Buffalo's LQM is provided in Appendix B. The Test America laboratory is capable of achieving organic and inorganic analyses detection limits that are suitable for the purpose of the project. A summary of Test America's most recent method detection and reporting limits for U.S. EPA Method SW-846 8260B, 8270CLL, and 6020 are presented in Table 3.

2.5 QUALITY CONTROL

This section discusses field and laboratory quality control requirements. Laboratory quality control requirements are dictated, in large part, by the analytical methods. Additional aspects of laboratory quality control are discussed in the selected laboratory's LQM.

2.5.1 Field Quality Control Requirements

Quality control in the field will be maintained through equipment calibration (discussed in Section 2.7.1 of this QAPP), measurement reproducibility, and the collection of QC samples.

2.5.1.1 Field Quality Control Samples

Quality control for field sampling efforts will primarily be measured via the collection of field QC samples, which consist of the following:

- Field duplicates;
- Equipment blanks; and,
- Trip blanks.

The data application and sample requirements for each are discussed in the following paragraphs.

Field Duplicates

Field duplicates are used to evaluate the laboratory analytical program for reproducibility of data. One field duplicate for each analysis will be analyzed at a rate of one per every 20 samples.

Field duplicates are collected simultaneously by splitting a sample evenly between the matrix and QC sample bottles. For instance, a groundwater sample bailer would be emptied, in relatively equal volumes, into two sample bottles (one matrix and one QC).

Equipment Blanks

Equipment blank data are used to evaluate field decontamination procedures. Equipment blanks will be collected by pouring analyte-free water, supplied by the analytical laboratory, through decontaminated sample equipment, and then into the sample bottles. Preservation and filtration will be performed as necessary for the appropriate analyses. If disposable equipment is used, the field blank will be taken from a rinse of the equipment prior to sampling use. One field blank per matrix will be sufficient for this project.

Trip Blanks

Trip blank data will be used to evaluate exposure to volatile organic constituents (VOCs) during sampling, shipping and storage at the laboratory. The prepared trip blanks are to be transported with the VOC vials to the field. One set of trip blanks will be included in each cooler containing VOC sample vials and will be analyzed only for the required VOCs.

2.5.2 Laboratory Quality Control Requirements

Quality control data are necessary to determine precision and accuracy of the analyses, and to demonstrate the absence of interferences and contamination of glassware and reagents. Laboratory-generated QC will consist of blanks, replicates, standards, matrix spikes, surrogate spikes and blanks. These will be prepared and analyzed at the method-required frequencies. Method-recommended matrix spiking solutions will be used to determine matrix effects. Surrogates will be added to all samples requiring gas chromatograph (GC) analyses (or as specified in the method). At a minimum, one method blank will be processed for every batch (up to 20 samples) analyzed. Blank samples will be analyzed in order to assess possible contamination and determine which corrective measures may be taken, if necessary.

Laboratory Duplicates

Replicate samples are aliquots of a single sample that are split upon arrival at the laboratory or prior to analysis. Laboratory duplicates are required by methods for inorganic analyses. Since it is anticipated that the concentrations of most organic parameters will be below the laboratory detection limits, precision data on replicate analyses will largely be derived from matrix spike duplicate data. Significant differences between two replicates that are split in a controlled laboratory environment will result in flagging of the affected analytical results.

Surrogate Analysis

Surrogate spike analysis is used to determine the recovery efficiency of analytes in the sample preparation and analysis. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method. A surrogate spike is prepared by adding to a sample (before extraction) a known amount of pure compound similar to that for which the sample is being analyzed. Surrogate compounds will be added to all samples that are to be analyzed for volatiles including method blanks, duplicate samples, and matrix spikes using the compounds recommended in the respective methods. If a recovery does not fall within these limits, the corrective actions described in the method will be implemented.

Matrix Spike/Matrix Spike Duplicate Analysis

This technique is used to determine the effect of matrix interference on analytical results. Aliquots of the same sample are prepared in the laboratory and each aliquot receives consistent treatment throughout the analytical method. Spikes are added at concentrations specified in the methods. Spike duplicates are prepared for organic analyses. The percent difference between the values of the spike duplicates is taken as a measure of the precision of the analytical method.

Method Blanks

Method blanks will be run for all appropriate analyses to verify that the procedures used do not introduce contaminants that affect the analytical results. The method blank will be prepared by addition of all reagents to a substance of similar matrix as the sample. This blank will then

undergo all of the procedures required for sample preparation. The resultant solution will be analyzed with the field samples prepared under identical conditions.

Deviations from the established QC criteria will be noted and reanalysis or other corrective action will be instituted as appropriate for the situation.

2.6 EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Field check summary sheets will be used to identify the most recent maintenance, battery charge, and equipment condition. Routine maintenance procedures will be noted in the field notebooks and may include:

- Removal of surface dirt and debris from exposed surfaces of the field measurement systems;
- Cleansing of the ionization chamber, lamp window, and any filters in a PID; and,
- Daily inspections of sampling equipment and measurement systems for possible problems (i.e., cracked or clogged lines or tubing or weak batteries).

Spare and replacement parts stored in the field to minimize downtime may include:

- Appropriately sized batteries;
- Locks;
- Decontamination supplies;
- Extra sample containers;
- Bailers;
- Bailer line;
- Calibration kit(s), battery charger, and support equipment;
- Health and safety supplies; and,
- Tool kit.

If damaged equipment is identified, it will be replaced by the same or equivalent model as soon as practicable. Field QA activities will be reported to the Contractor Project Manager and QA Officer. Problems encountered during the program affecting quality will be reported. The Project Manager/QA Officer will be responsible for initiating the corrective actions and for ensuring that the actions are taken in a timely manner and that the desired results are produced.

During the course of the corrective actions, the field personnel will be responsible for seeing that field instruments are functioning properly and that work progresses satisfactorily. Additionally, field personnel are responsible for the performance of routine preventive maintenance and QC procedures.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

This section discusses instrument calibration procedures and frequency of calibration. Field instrument calibration is discussed in Section 2.7.1. Laboratory instrument calibration is discussed in Section 2.7.2.

2.7.1 Field Instrument Calibration

Precision and accuracy of field measurements will be maintained in two ways:

- Through daily calibration of each instrument in accordance with the manufacturer's procedures; and,
- By checking the reproducibility of the measurement by obtaining and recording multiple readings.

2.7.1.1 Equipment Requirements

The following field equipment is anticipated for use during the Workplan, for various screening, monitoring, and measurement tasks:

- Electronic groundwater and non-aqueous phase liquid (NAPL) depth measuring devices;
- PID;
- In Situ groundwater collection method (i.e. Geoprobe® Screen Point Sampler);
- Groundwater sampling pumps such as peristaltic pumps; and,
- Field meters for measuring pH, turbidity, temperature, dissolved oxygen, specific conductance (i.e. Horiba™).

2.7.1.2 Calibration Requirements

All equipment will be calibrated daily for each day of use, or more frequently if necessary. Calibration information is to be recorded on the equipment calibration forms or in the field notebook. If calibration difficulties are experienced for a given piece of equipment, the Contractor or subcontractor responsible for equipment upkeep will replace the equipment with a similar, or equivalent model, as soon as is practicable.

2.7.2 Laboratory Instrument Calibration

Calibration of laboratory equipment will be accomplished according to published procedures associated with specific methods of analysis and U.S. EPA guidance. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be potentially subject to QA audit. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts, or maintain service contracts with vendors.

2.8 DATA ACQUISITION

Data will be transferred electronically or by computer diskette directly from the laboratory to the Contractor. Once received by the Contractor, data will be reduced and formatted in easily interpreted tables in Excel format. From this format, data will also be electronically transferred into the Contractor's Data Management System.

2.9 DATA MANAGEMENT

The analytical, survey and geological electronic and hardcopy data will be managed and maintained by the Contractor. Any requests for these data by third parties must be first approved by Beazer. Data management for the project has the following objectives:

- Establish a controlled, functional, and efficiently operated data management system and accompanying procedures to manage, analyze, document, and transfer the environmental data that are collected and generated.
- Maintain a usable and accurate database throughout the life of the project.
- Process specific data requests from project and Beazer personnel.
- Transfer specific data components to other parties, as appropriate.
- Archive the database and related documentation upon closure of the project.

2.9.1 Data Transmittal, Transformation, and Analysis

Upon receipt of data from the analytical laboratory, Contractor personnel will ensure that all data packages are complete. If data packages are determined to be incomplete, the laboratory will be contacted and will be required to promptly provide the missing information. Contractor personnel will be responsible for transcribing all data, including electronically transferred data (i.e., electronic data deliverables [EDDs]), into tables suitable for data review. After review and validation, field and laboratory data will be entered into the database with appropriate qualifiers.

Contractor personnel will review Level III data to ascertain that the laboratory has provided the following information:

- Results for all samples submitted;
- Correct reporting units;
- Documentation of acceptable matrix spike duplicate and surrogate recoveries;
- Acceptable standard and preparation blank results; and,
- Appropriate qualifiers of data for which results are reported below the detection limit or for analytes that are also detected in method or preparation blanks.

Tables containing analytical data will be generated through queries from the database and compared against the applicable criteria. Geographic Information System (GIS) data may be used to generate boring logs, groundwater flow maps, and isoconcentration plots.

Geologic data obtained from boring logs, well construction information, and survey coordinates and elevations will also be entered. The data will be reviewed for accuracy and completeness.

Any difficulties originating from the EDD format shall be resolved with the laboratory before the data are imported. Upon importing analytical data, a random sampling will be verified against the associated hard copy data and a copy of the reviewed electronic data printout will be annotated, signed, and retained in the project file.

2.9.2 Data Storage and Retrieval

All electronic data will reside in the Contractor database to be accessed and managed by the Contractor. All records will be maintained by the Contractor until project completion and closeout.

Upon completion of all data review and/or validation, Contractor personnel will prepare data summary tables, as applicable. The Contractor Project Manager is responsible for ensuring that no errors are introduced in data transcription. Both the Contractor Investigation Task Leader and the QA Officer will review and/or check all data tables.

Data not suited to entry into the database will be included or summarized in reports to management, and data reports will be made part of the permanent project file. The Contractor's Project Manager will be responsible for ensuring that all data are included in the permanent project file.

3.0 ASSESSMENT/OVERSIGHT

3.1 ASSESSMENT AND RESPONSE ACTIONS

The assessment and oversight of the project activities may include a process of review and evaluation through systems audits, performance audits, internal peer review, and laboratory oversight. This process will ensure that the QAPP is adhered to, the quality of the data is adequate, and corrective actions, when needed, are implemented effectively and in a timely manner.

3.1.1 Technical Systems Audits

Systems audits performed by the QA/QC Officer or designee may encompass evaluation of QA components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits will be conducted if Beazer requests an unscheduled audit or conditions that may compromise quality are identified. The Systems Audit (if required) will consist of an inspection of the following procedures:

- Sampling
- Sample custody
- Sample storage and preservation
- Sample preparation
- Analytical methodology
- Data management
- Preventive maintenance
- Recordkeeping

3.1.2 Technical Performance Audits

Performance audits may be conducted to determine conformance to the QAPP. As in system audits, unplanned audits may be implemented if requested. Performance audits will be performed after sampling activities commence and the project begins to generate data. These audits document that sampling, custody, and record-keeping in the field are in compliance with applicable requirements of the QAPP.

3.1.2.1 Field Performance Audits

A field performance audit may be conducted at the discretion of the Project Manager to ensure that field personnel are in compliance with the Workplan and applicable SOPs. Each audit shall cover the items necessary to verify proper control of the activities within the defined scope of work. Concerns such as equipment inspections and calibration, personnel training, decontamination, field screening, sample collection, sample shipping and chain-of-custody procedures, and document control are included in a field audit.

The mobilization stage may be audited before work begins to assure that all procedures, training, and materials are in place to support the QAPP. Field activities may be audited during the initial stage to assure compliance with the QAPP. Additional audits may be required depending on the results of these audits. All audits and corrective actions will be reported in writing to the Project Manager.

3.1.2.2 Laboratory Audits

A Texas certified laboratory will be used for this program. If conditions are noted that indicate potential quality issues with analytical results, an audit may be conducted at the recommendation of the QA/QC Officer. This audit shall consist of a general audit and a specific procedure audit. A general audit will be an overview of the whole laboratory from sample receipt to sample disposal. A specific technical audit will be a detailed in depth review of an actual method or procedure.

The findings from any audit conducted will be documented on a laboratory audit record form. Any issues, observations, and findings shall be discussed with the Laboratory Manager. The results of the audit shall be kept on file along with any corrective action taken. If, as a result of the audit, there is uncertainty as to the validity or correctness of a test result, immediate corrective action should be taken and the client notified in writing.

3.2 CORRECTIVE ACTION PROTOCOLS

Project management and staff, including field investigation teams, quality assurance auditors, sample control personnel, and laboratory groups, will monitor ongoing work performance in the normal course of daily responsibilities. When a significant condition adverse to quality is noted at the project location or laboratory, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned and taken will be documented and reported to the Project Manager. Implementation of correction action will be verified by documented follow-up action. All project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality, and solicit correction. Corrective actions may be initiated under the following (for example):

- When predetermined acceptance standards are not attained (objectives for precision, accuracy, and completeness);
- When procedures or data compiled are determined to be incorrect or incomplete;
- When equipment or instrumentation is found to be malfunctioning;
- When samples and test results cannot be traced with certainty;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits; or,
- As a result of a management assessment.

Corrective actions shall be documented using appropriate field and laboratory forms. All corrective action forms shall be entered into the project files.

3.3 REPORTS TO MANAGEMENT

As needed, progress reports will be prepared by the Contractor, or designate, and submitted to Beazer. Quality assurance reports to management will consist of reports on audits, reports on correction of deficiencies found in audits, a final QA report on field sampling activities, and a final analytical laboratory QA/QC report.

4.0 DATA VALIDATION AND USABILITY

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION

This section discusses data review, validation, and verification. Field data are discussed in Section 4.1.1. Laboratory data are discussed in Section 4.1.2.

4.1.1 Field Data

Field data will be reviewed using four different procedures:

- Routine checks will be made during the processing of data, i.e., looking for errors in identification codes;
- Internal consistency of a data set will be evaluated. This step will involve plotting the data and testing for outliers;
- Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified; and,
- Checks will be made for consistency with parallel data sets; i.e., data sets obtained from the same population (for example, from the same region of the aquifer).

The purpose of these validation checks and tests is to identify outliers; i.e., an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrumentation breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected.

After an outlier has been identified, a decision concerning its factual basis must be made. Obvious mistakes in data will be corrected when possible, and the correct values inserted. If the correct values cannot be obtained, the data may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier with both inclusion and exclusion from the data set.

4.1.2 Laboratory Data

Prior to submitting analytical data to the Contractor, the laboratory must verify compliance to the method requirements. The laboratory will follow their QA/QC manual, SOPs, and this QAPP for all sample analyses. The laboratory will also be responsible for the oversight of the data quality for all analyses. Any sample integrity issues, discrepancies with the chain of custody, or

concerns with the analysis will be addressed and resolved through the Laboratory QA/QC Officer.

All analytical data and calculations shall be reviewed by the laboratory and shall include a minimum of three levels of documented review, including analyst review, peer review and supervisory review. For each level, the review process shall be documented, signed and dated by the reviewer. Each step of this review process shall include the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. All electronic deliverables must be checked against the hard-copy reports to ensure that the two versions match. Laboratory data will be reported to include the following information:

- Summary and QA/QC narrative;
- Original Chain of Custody form;
- Sample receipt form documenting sample condition;
- Sample results with method reference, dates of sample receipt, preparation, and analysis noted on report form;
- Dilution/concentration factors;
- Sample-specific reporting limits;
- Surrogate recoveries;
- Method blank results linked to field samples;
- Matrix spike results, matrix spike duplicate results, recovery, and precision values;
- Laboratory control sample results;
- Duplicate sample results; and,
- Summaries of initial and continuing calibration analyses.

4.2 VALIDATION AND VERIFICATION METHODS

To ensure the utility of the sample results, a data usability assessment of the analytical data will be completed. This review will be completed by the Contractor's QA/QC Officer. The analytical results generated via SW-846 Method 8260B will be reviewed in accordance with specific critical components of relevant U.S. EPA guidance for data validation. Specifically, analytical results will be reviewed considering the following general rubrics:

- Sample holding time compliance
- Acceptable surrogate spike recoveries
- Laboratory method blank artifacts
- MS/MSD RPDs and recoveries
- Field duplicate RPDs

The analytical results will be reviewed to ensure that samples were analyzed within an acceptable time frame (based on the date of sample collection). Surrogate recoveries will be reviewed to determine if the Gas Chromatography/Mass Spectrometry instrumentation was performing adequately. Method blank results will be reviewed to identify the possibility of laboratory contamination of the samples. The MS/MSD results will provide an indication of the

precision of the analytical method given the potential for matrix interference effects. The field duplicates will be used to document the precision of the sampling process.

The data usability assessment will be completed in accordance with applicable sections of the following guidance document: U.S. EPA's Contract Laboratory Program, National Functional Guidelines for Organic Data Review, and National Functional Guidelines for Inorganic Data Review. As required, this guidance document will be used in conjunction with the laboratory SOPs for the respective analytical methods. Professional judgment will be exercised throughout the data assessment effort, particularly for situations that are not addressed or clearly specified in the SOPs or in the guidance documents.

4.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Results from review/validation of field activities and analytical data will be integrated to allow a final reconciliation of achieved data quality with the stated DQOs.

Accuracy, precision, and completeness will be calculated in accordance with the formulas provided in this document. Representativeness will be evaluated based on the implementation of the field sampling program and analytical program with attention paid to evidence of non-homogeneity of samples. Reporting limits will be compared to applicable criteria to evaluate whether adequate sensitivity was achieved. Sampling and analysis methods and results will be reviewed against historical data or data from other related locations to determine comparability.

4.3.1 Data Quality Assessment

The TI Zone Delineation Report will identify any areas of concern where objectives were not met and evaluate the impact of these upon the intended uses of the data. Specific samples or analytes for which the uncertainty exceeds program or project-specific objectives will be identified so that Beazer may make informed decisions on the potential impact to the overall program.

5.0 REFERENCES

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- American Society of Agronomy, Inc., Methods of Soil Analysis, Number 9, Part 2, page 570, (Walkley-Black Procedure);
- Beazer, April 2005, Supplemental Groundwater Characterization Workplan, South Cavalcade Superfund Site, Houston, Texas.
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- U.S. EPA, October 6, 1995, South Cavalcade Street Superfund Site Groundwater Exposure Assessment Work Plan, September 1996, EPA Review Comments.
- U.S. EPA August 14, 1997, Letter from Glenn Celerier to Mr. Mike Slenska, P.E.
- U.S. EPA, 1998 Record of Decision (ROD) for the South Cavalcade Site.
- U.S. EPA, July 8, 1998, Letter from Glenn Celerier to Mike Bollinger, P.E. (Beazer).
- U.S. EPA, August 2000, Guidance for the Data Quality Objectives Process, EPA QA/G-4.
- U.S. EPA, March 2001, EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5.
- U.S. EPA, December 2002, EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5.
- U.S. EPA, Contract Laboratory Program, National Functional Guidelines for Organic Data Review.
- U.S. EPA, Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review.

TABLES

TABLE 1

**SAMPLE COLLECTION SUMMARY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS**

Task	Sample Method	Sample Analysis	Analytical Method
Temporary Monitoring Well Sampling	Low Flow Purge and Sampling (See Text of Work Plan)	Field Parameters TCL VOCs TCL SVOCs Metal COIs	See Notes SW846 8260B SW846 8270C LL SW846 6020
Existing Monitoring Well and Piezometer Sampling	Low Flow Purge and Sampling (See Text of Work Plan)	Field Parameters TCL VOCs TCL SVOCs Metal COIs	See Notes SW846 8260B SW846 8270C LL SW846 6020

Notes:

Methods are from "U.S. EPA, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW846, third ed., as revised and updated.

"Field Parameters" include pH, specific conductance, temperature, dissolved oxygen, oxidation/reduction potential (ORP), and turbidity, as measured by a field instrument, e.g. Horiba™

TABLE 2
ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Matrix Sample Summary			QC Sample Summary				Analytical Requirements Summary				
Analytical Parameter	Matrix	No. of Samples	Field Duplicates	Equipment Blanks	MS/MSDs	Trip Blanks	Method Reference	Container Type	Required Sample Volume	Preservation	Holding Time
Temporary Monitoring Well Sampling	Water	33	2	1	2	1/trip	8260B	Glass Vials	3- 40mL w/Teflon septum	4°C + HCl	14 Days
							8270C LL	Amber Glass	2-1 liter bottles	None	7 Days to Extraction
							6020	Plastic	500mL	HNO ₃	6 Months
Existing Monitoring Well and Piezometer Sampling	Water	26	2	1	2	1/trip	8260B	Glass Vials	340mL w/Teflon septum	4°C + HCl	14 Days
							8270C LL	Amber Glass	2-1 liter bottles	None	7 Days to Extraction
							6020	Plastic	500mL	HNO ₃	6 Months

Notes:

Methods are from "U.S. EPA, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW846, third ed., as revised and updated.

TABLE 3
LABORATORY MDL/RL SUMMARY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

COI	MDL (ug/L)	RL (ug/L)
TCL VOCs		
1,1,1-Trichloroethane	0.82	1
1,1,2,2-Tetrachloroethane	0.21	1
1,1,2-Trichloroethane	0.23	1
1,1,2-Trichloro-1,2,2-trifluorethane	0.31	1
1,1-Dichloroethane	0.38	1
1,1-Dichloroethene	0.29	1
1,2,4-Trichlorobenzene	0.41	1
1,2-Dibromo-3-Chloropropane	0.39	1
1,2-Dibromoethane	0.73	1
1,2-Dichlorobenzene	0.79	1
1,2-Dichloroethane	0.21	1
1,2-Dichloropropane	0.72	1
1,3-Dichlorobenzene	0.78	1
1,4-Dichlorobenzene	0.84	1
2-Hexanone	1.24	5
2-Butanone	1.32	10
4-Methyl-2-pentanone	2.1	5
Acetone	3	10
Benzene	0.41	1
Bromodichloromethane	0.39	1
Bromoform	0.26	1
Bromomethane	0.69	1
Carbon Disulfide	0.19	1
Carbon Tetrachloride	0.27	1
Chlorobenzene	0.75	1
Dibromochloromethane	0.32	1
Chloroethane	0.32	1
Chloroform	0.34	1
Chloromethane	0.35	1
cis-1,2-Dichloroethene	0.81	1

TABLE 3
LABORATORY MDL/RL SUMMARY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

COI	MDL (ug/L)	RL (ug/L)
cis-1,3-Dichloropropene	0.36	1
Cyclohexane	0.18	1
Dichlorodifluoromethane	0.68	1
Ethylbenzene	0.74	1
Isopropylbenzene	0.79	1
Methyl acetate	0.5	1
Methyl tert-butyl ether	0.16	1
Methylcyclohexane	0.16	1
Methylene chloride	0.44	1
Styrene	0.73	1
Tetrachloroethene	0.36	1
Toluene	0.51	1
trans-1,2-Dichloroethene	0.9	1
trans-1,3-Dichloropropene	0.37	1
Trichloroethene	0.46	1
Trichlorofluoromethane	0.88	1
Vinyl chloride	0.9	1
Xylenes, Total	0.66	2
TCL SVOCs		
Biphenyl	0.034	5
bis(2-chloroisopropyl)ether	0.086	5
2,4,5-Trichlorophenol	0.065	5
2,4,6-Trichlorophenol	0.072	5
2,4-Dichlorophenol	0.056	0.5
2,4-Dimethylphenol	0.3	1
2,4-Dinitrophenol	0.6	5
2,4-Dinitrotoluene	0.034	5
2,6-Dinitrotoluene	0.091	5
2-Chloronaphthalene	0.066	0.5
2-Chlorophenol	0.066	5
2-Methylnaphthalene	0.052	0.5

TABLE 3
LABORATORY MDL/RL SUMMARY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

COI	MDL (ug/L)	RL (ug/L)
2-Methylphenol	0.14	1
2-Nitroaniline	0.095	5
2-Nitrophenol	0.062	5
3,3'-Dichlorobenzidine	0.22	5
3-Nitroaniline	0.13	5
4,6-Dinitro-2-methylphenol	0.74	5
4-Bromophenyl phenyl ether	0.091	5
4-Chloro-3-methylphenol	0.053	5
4-Chloroaniline	0.13	5
4-Chlorophenyl phenyl ether	0.046	5
4-Methylphenol	0.094	1
4-Nitroaniline	0.025	5
4-Nitrophenol	0.39	5
Acenaphthene	0.036	0.5
Acenaphthylene	0.056	0.3
Acetophenone	0.1	5
Anthracene	0.034	0.5
Atrazine	0.29	2
Benzaldehyde	0.075	5
Benzo(a)anthracene	0.034	0.3
Benzo(a)pyrene	0.13	0.18
Benzo(b)fluoranthene	0.063	0.3
Benzo(g,h,i)perylene	0.058	0.5
Benzo(k)fluoranthene	0.07	0.3
Bis(2-chloroethoxy)methane	0.064	5
Bis(2-chloroethyl)ether	0.072	5
Bis(2-ethylhexyl)phthalate	0.42	5
Butyl benzyl phthalate	0.16	3
Caprolactam	0.22	5
Carbazole	0.079	5
Chrysene	0.074	0.5

TABLE 3
LABORATORY MDL/RL SUMMARY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

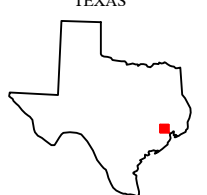
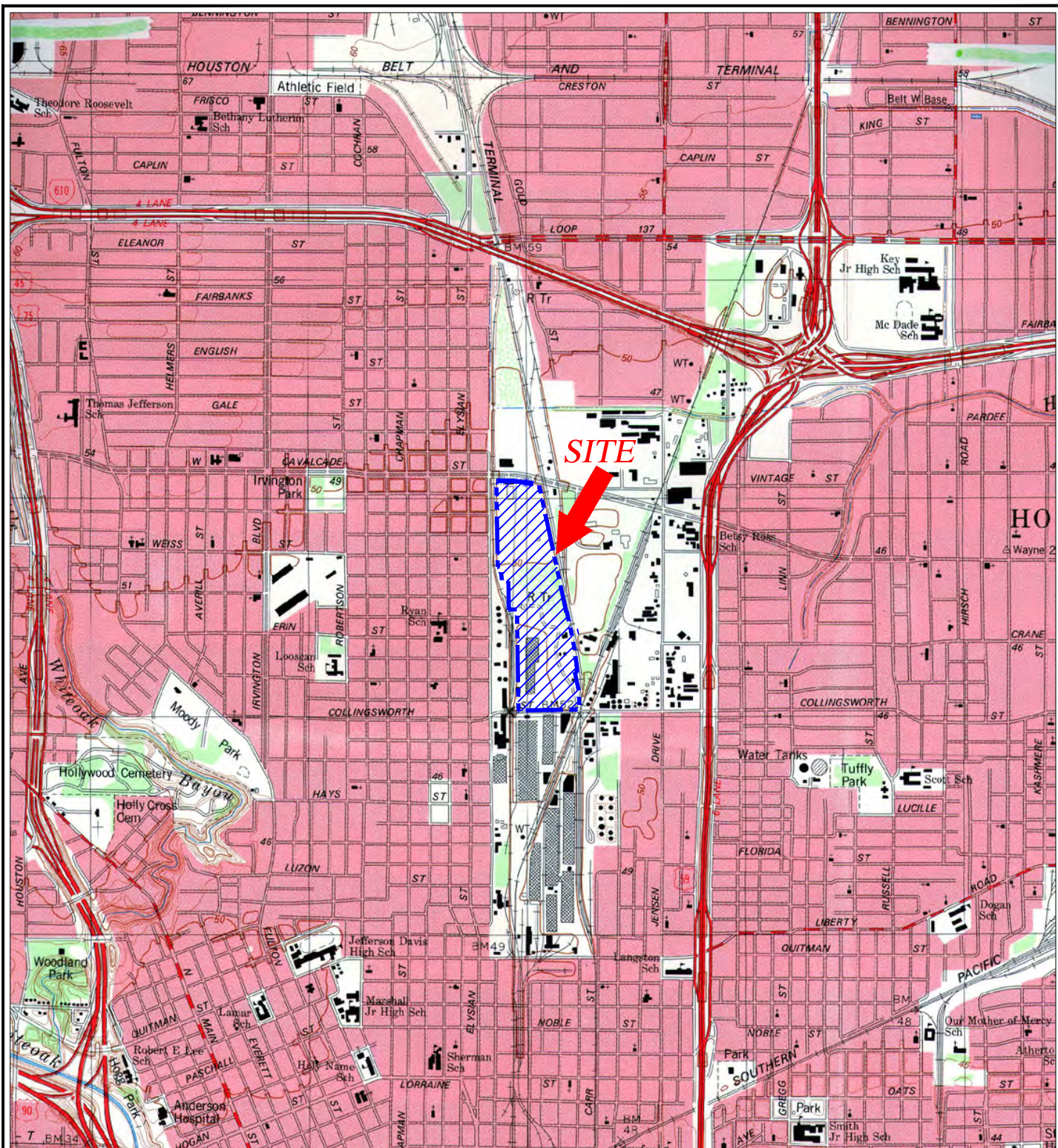
COI	MDL (ug/L)	RL (ug/L)
Dibenz(a,h)anthracene	0.07	0.5
Dibenzofuran	0.06	5
Diethyl phthalate	0.064	0.5
Dimethyl phthalate	0.057	0.5
Di-n-butyl phthalate	0.35	2
Di-n-octyl phthalate	0.2	5
Fluoranthene	0.08	0.5
Fluorene	0.058	0.5
Hexachlorobenzene	0.22	0.5
Hexachlorobutadiene	0.1	1
Hexachlorocyclopentadiene	0.091	1
Hexachloroethane	0.088	5
Indeno(1,2,3-cd)pyrene	0.11	0.5
Isophorone	0.051	0.5
Naphthalene	0.064	1
Nitrobenzene	0.065	0.5
N-Nitrosodi-n-propylamine	0.06	5
N-Nitrosodiphenylamine	0.07	5
Pentachlorophenol	0.3407	1
Phenanthrene	0.062	0.2
Phenol	0.1	1
Pyrene	0.076	0.5
METALS		
Arsenic	0.078	1
Chromium	0.07	1.5
Copper	0.22	1
Lead	0.069	1
Zinc	1.1	10

MDL – Method Detection Limit per most recent Test America – Buffalo study.

RL – Reporting Limit

FIGURES

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QUADRANGLE LOCATION

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
OF SETTEGAST, TEXAS - 1982

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

BEAZER EAST, INC
PITTSBURGH, PENNSYLVANIA

DRWN: SCC DATE: 04/23/13
CHKD: BLH DATE: 04/23/13
APPD: JSZ DATE: 04/23/13
SCALE: 1" = 2000'

KEY ENVIRONMENTAL
INCORPORATED

QUALITY ASSURANCE PROJECT PLAN
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

SITE LOCATION MAP

PROJECT NO: 13-665

FIGURE 1

007089

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graph TD; B["Beazer Project Manager  
(Mike Bollinger)"] -.-> EPA["U.S. EPA Project Manager"]; B --> CPM["Contractor Project  
Manager"]; CPM -.-> HSO["Project H&S Officer"]; CPM -.-> QA["QA Officer"]; CPM --> SHSO["Site H&S Officer"]; CPM --> ITL["Investigation Task Leader"]; CPM --> PHE["Project Hydrogeologist/  
Engineer"]; SHSO --> Base["Site Geologist, Site H&S Technician, Field Technicians, Technical and Administrative Staff"]; ITL --> Base; PHE --> Base;
```

Analytical Laboratory	Geoprobe/Drilling	Professional Surveyor	IDW Disposal
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LEGEND

- SITE BOUNDARY
- PROPERTY BOUNDARIES
- - - PROPOSED HARDY TOLL ROAD EXTENSION RIGHT-OF-WAY
- [Stippled Pattern] AREAS COVERED WITH ASPHALT OR CONCRETE
- [Hatched Pattern] CONCRETE CAP CONSTRUCTED BY BEAZER



△			
△			
△			
REV #	DATE	DESCRIPTION	APPD

REFERENCE: PROPOSED HARDY TOLL ROAD EXTENSION RIGHT-OF-WAY BASED ON HARDY CONNECTOR SCHEMATIC – FROM: US59/IHIO INTERCHANGE TO: HARDY TOLL ROAD/IHIO610 INTERCHANGE, DANNENBAUM ENGINEERING CORPORATION, 07/24/2009.

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

BEAZER EAST, INC.
PITTSBURGH, PENNSYLVANIA

DRWN: SCC	DATE: 04/23/13	
CHKD: BLH	DATE: 04/23/13	
APPD: JSZ	DATE: 04/23/13	
SCALE:	AS SHOWN	

QUALITY ASSURANCE PROJECT PLAN
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

SITE PLAN	PROJECT NO: 13-665 FIGURE 3
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APPENDIX A

KEY STANDARD OPERATING PROCEDURES

- **SOP 03 – FIELD LOGBOOK**
- **SOP 22 – ENVIRONMENTAL SAMPLE PREPARATION**
- **SOP 23 – SAMPLE HANDLING, PRESERVATION, PACKAGING
AND SHIPPING**
- **SOP 24 – CHAIN OF CUSTODY**

03 - FIELD LOGBOOK

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) establishes the requirements of the entry of information into logbooks to ensure that KEY field activities are properly documented. Field logbooks are the primary source of documentation for site activities, and serve as legal record of all occurrences during those activities. The project manager and the field team leader are responsible for ensuring the logbook entries provide sufficient information for the completion of an accurate and detailed description of field operations.

Complete and accurate logbook entries are essential to

- Ensure that data collection associated with field activities is sufficient to support the successful completion of the project
- Provide sufficient information that someone not affiliated with the project can independently reconstruct the field activities at a later date
- Maintain quality control throughout the project
- Document changes to or deviations from the Work Plan
- Fulfill administrative needs of a project
- Support potential legal proceedings associated with a specific project

1.1 Referenced SOPs

None

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

The required materials for maintaining a field log book include a water-resistant, permanently bound notebook (such as *Rite in the Rain ALL-WEATHER ENVIRONMENTAL No. 550F* notebook (or equivalent)) and a pen with permanent ink.

3.0 METHODOLOGIES

Pertinent information regarding the site and work procedures must be documented. Information recorded in the notebook should be noted with the date and time of entry. Each field crew shall maintain a single logbook. Legibility must be maintained. The following items are commonly included as logbook entries:

- Name and location of site
- Date and time of arrival and departure
- Name and affiliation of person keeping log
- Names and affiliations of project personnel present on site
- Sampling event description; including methodology, sample numbers and volumes, description of samples, date and time of sample collection, and name of collector
- Prevailing weather conditions and weather delays
- Technical measurements and readings, with notation of anomalous measurements
- Record of phone calls/and or contact with individuals at the site
- Record of approval of field changes to the scope of work
- Diagrams and sketches as needed to document sample locations
- Physical obstructions encountered during field activities
- Reference to global positioning system data collected, if applicable
- Description of equipment used
- Equipment problems encountered and resolution of such problems
- Management or disposal of investigation-derived wastes
- List and descriptions of photographs including camera used, photographer's name, and the direction or view angle of the photograph
- Equipment calibration information

Information should be recorded in permanent ink for the legal record. The company name, address, and phone number should be entered at the beginning of the log book. The title page should also include the start/finish dates for the activity, and whether more than one logbook is included in the record (e.g., Book __ of __). The pages of the logbook should be numbered for ease of reference. Blank spaces should be crossed out and initialed. No pages may be removed from the logbook for any reason.

All notes should be written at the time of observation. If this is not possible, the logbook should indicate when the observations were recorded and the reason for the delay. Changes or deletions should be crossed out with a single line and initialed by the individual making the change.

At the end of each field day, the project scientist/engineer or designee should sign and date each page of the notebook on which entries were made to verify the day's activities. Unused lines at the end of each day's work shall be marked with a diagonal line, signed and dated. The field team leader (or designee) must also sign and date the final daily entry page of each field crew member maintaining a separate logbook. Each day's work shall be recorded starting on a new page, with the date, time, weather conditions, and team members present.

On at least a weekly basis, completed pages must be copied to the project files on the office served so that the loss or accidental destruction of the logbook will result in a minimal loss of data. Copies shall be reviewed to ensure that they are legible.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

At the end of each day of field activities, the individual or individuals maintaining the field logbook should review the notes for accuracy and completeness. Corrections, deletions, or additions should be stricken, initialed and dated.

5.0 DOCUMENTATION AND RECORD KEEPING

The first page of all field logbooks must contain the holder's name and contact information.

It is recommended that a running activity log be maintained, indicating the times of activities and observations; recorded data be written in the form of tables with an appropriate title; and that diagrams be included to illustrate pertinent information. Logbooks should be labeled with the project name, project number, and a consecutive number for cataloging purposes.

Copies made for the project file will become the primary record of the job activities. The filled logbook remains a working copy until project completion, at which time the logbook is physically stored in the project files.

6.0 REFERENCES

Environmental Research Center, University of Nevada - Las Vegas, March 1989, Soil Sampling Quality Assurance User's Guide: U.S. Environmental Protection Agency EPA/600/8-89/046, 260 p.

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U.S. EPA, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: Office of Solid Waste and Emergency Response, OSWER 9355.3-01. <http://www.epa.gov/superfund/policy/remedy/pdfs/540g-89004-s.pdf>.

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U.S. EPA, 1991, Guidance for Performing Site Inspections Under CERCLA: Office of Solid Waste and Emergency Response, OSWER 9345.1-05. <http://www.epa.gov/superfund/sites/npl/hrsres/>.

22 - ENVIRONMENTAL SAMPLE PREPARATION

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents procedures for selecting appropriate sample containers and preservatives when collecting environmental samples for analysis at a selected laboratory. Procedures for packaging and shipping environmental samples are presented in KEY SOP 23 – *Sample Handling, Preservation, Packaging and Shipping*.

Environmental samples are those that are anticipated to be relatively low in analyte concentration. These samples consist of materials that may have been impacted by source area materials, but do not consist of source area materials such as sludge, material from drums, material from bulk storage tanks, *etc.* Examples of environmental samples include: soil samples collected adjacent to or underlying a source area, stream and sediment samples, and groundwater samples (which do not contain non-aqueous phase liquid).

1.1 Referenced SOPs

23 – Sample Handling, Preservation, Packaging and Shipping

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

Required materials for sample containers and preservation may include:

- Laboratory-provided various sized glass containers (with Teflon[®]-lined lids or caps, clear or amber colored) as required for analysis
- Laboratory-provided various sized polyethylene containers (with Teflon[®]-lined lids or caps) as required for analysis
- Nitric acid
- Sulfuric acid
- Hydrochloric acid
- Sodium hydroxide
- Sodium thiosulfate
- Filtration equipment, if required

Project-specific, appropriate sample container size, sample volume, holding times, and preservatives should be presented in the Quality Assurance Project Plan (QAPP). The selected laboratory should be able to provide the most complete guidance on this topic, and will have been consulted during the preparation of the QAPP. This SOP is intended to provide general information to field and office personnel while preparing the project planning documents, ordering and shipping supplies, and performing sample collection activities.

3.0 METHODOLOGIES

3.1 Sample Containers

To limit potential chemical or physical changes in a sample during collection and transport, the sample container selection should be based on the following:

- Sample containers should be new and certified clean prior to sampling activities
- Sample containers should be constructed of non-reactive materials
- Sample containers should not chemically or physically alter the sample

The most widely used containers for aqueous samples are composed of glass or polyethylene.

3.2 Aqueous Samples

Glass Containers

Glass containers will be used when organic compounds are the analytes of interest. Sample volume will be sufficient to fill each sample container to allow the laboratory to attain the method-specific detection limits. Specific to volatile organic analysis, sample volume will be sufficient to fill each sample container so that no air bubbles are present. Once the sample container is full and preserved, if appropriate, it will be sealed with a Teflon[®]-lined screw cap. Specific container sizes for each analytical category are presented in the project-specific QAPP.

Polyethylene Containers

Polyethylene containers will be used for aqueous samples when metals and/or inorganic analytes are the parameters of interest. One-liter polyethylene bottles with solid polyethylene or polyethylene-lined caps will generally be used to collect groundwater samples for metals and inorganic analysis. Once the sample container is full and preserved, if appropriate, it will be sealed with the polyethylene screw cap. Specific container sizes for each analytical category are presented in the project-specific QAPP.

3.2 Solid Samples

Sample containers for the soil matrix are typically clear glass with a volume of 8 ounces. Larger sample containers may be necessary depending upon the number and type of analyses.

3.3 Sample Preservation

Sample preservation is important to retard physical and chemical alterations of unstable analytes within the sample matrix. Sample preservation methods are limited and are generally intended to:

- Retard biological action
- Retard hydrolysis of chemical compounds and complexes

- Limit photolysis
- Reduce volatility of constituents
- Reduce sorption effects

Preservation is usually limited to acidification, treatment with an alkaline chemical, reducing light exposure, filtration, and refrigeration.

Prior to any form of preservation, the following parameters, at a minimum, will be measured in the field on water samples and recorded in the field notebook:

- pH
- Specific conductance
- Temperature

These field measurements record baseline information on the water sample prior to external influences such as temperature, dissolved carbon dioxide, or oxygen affecting the sample.

Acidification

Acidification of samples is generally performed for two purposes. Acidifying a (water) sample serves to limit metal adsorption to the sample container and will maintain the metal in a dissolved state. Secondly, acidification will act to inhibit bacterial growth. Samples to be acidified for either purpose will require a minimum volume of 100 ml and will be acidified to a pH < 2. Acidification is performed immediately after taking field measurements or following sample filtration.

Alkaline Treatment

Samples are preserved with an alkaline chemical (*e.g.* NaOH) to form salts with volatile compounds such as cyanide. Samples undergoing this preservation require a minimum volume of 100 ml and will be treated to a pH >12.

Preservation of the sample will be performed by the addition of NaOH until the desired pH is achieved (pH > 12). Preservation of a water sample is performed immediately after the field measurements are collected and recorded.

Filtration

Filtration of samples will be used only for specific analytical parameters. It will be used when the dissolved metal content of water is of concern. Filtration will not be performed for samples to be analyzed for volatile organics, semi-volatile organics, or total recoverable metals.

When sample filtration is required, the sample will be drawn through a 0.45 micron filter. The filter material will either be paper or fiberglass dependent on the nature of the sampled water. Filtration is performed immediately following the field measurements and prior to any other

preservation methods. If the sample contains a significant level of suspended solids, a paper prefilter will be used prior to the 0.45 micron filter.

Temperature Control

All field samples that are to be analyzed by the laboratory will be sealed and then refrigerated during transfer to and storage at the laboratory. Refrigeration of samples is a bacterial inhibitor and slows the chemical and biological changes of a sample exposed to an oxidizing atmosphere. Transfer and storage of samples will be between 0°C and 10°C, with a target temperature of 4°C. Solid samples are typically limited to this preservation method.

3.4 Laboratory Selection and Coordination

Choosing a qualified analytical laboratory is an integral part of sampling activities. Regulatory program requirements and certifications must be considered in selecting the laboratory to ensure that the laboratory is capable of meeting project-specific requirements. Also, the provisions of any Consent Orders or Unilateral Orders applicable to the project must be reviewed and communicated to the laboratory to ensure project-specific requirements are met.

Laboratory Selection

An analytical laboratory will be chosen based on the following criteria:

- Capabilities of the laboratory including performance history, certifications, and regulatory program experience
- The qualifications and experience of the laboratory staff
- Availability of a designated technical client representative who serves as a single point of contact for all KEY projects
- Quality and completeness of standard deliverables, including electronic data transfer availability
- The specified analyses and turnaround time
- The adequacy of the laboratory's quality assurance/quality control program

Coordination

After selecting a laboratory, the laboratory will be contacted and the following information requested pertaining to the sampling activities:

- Identification of a responsible party to act as sample custodian at the laboratory who is authorized to accept samples and verify the data entered from the accompanying chain-of-custody forms into the laboratory tracking system
- Provisions for a laboratory sample custody log consisting of serially numbered, standard laboratory tracking report sheets
- Specifications of laboratory sample custody procedures for sample handling, storage, and disbursement for analysis

The laboratory will be notified within 48 hours prior to receipt of samples. The samples will be packaged and shipped *via* express courier or hand delivered within 48 hours of collection to the laboratory. The laboratory will then be contacted to verify receipt of the samples and estimated turnaround time.

3.5 Sample Packaging and Shipping

Proper sample packaging and shipping accomplishes the following:

- Allows individual samples to be tracked through transport and analysis
- Limits the possibility of breaking or losing a sample bottle during transport
- Is part of formal chain-of-custody (COC) procedures (tracking of possession of the samples)

Samples will be packaged and shipped according to the procedures in *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

(Reserved)

5.0 DATA RECORDING OR MANAGEMENT

(Reserved)

6.0 REFERENCES

U.S. Environmental Protection Agency, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document: Washington, D.C., OSWER-9950.1.

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods - SW-846 3rd Edition (with revisions): Washington, D.C.

U.S. Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, Part 1: Washington, D.C., EPA/540/P-87/001.

U.S. Environmental Protection Agency, 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA/540/P-91/007.

23 - SAMPLE HANDLING, PRESERVATION, PACKAGING AND SHIPPING

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes the procedures associated with the handling, preservation, packaging, and shipment of environmental samples for laboratory analysis or testing. Environmental samples may consist of air, groundwater, surface water, sediments or soil. The objective of sample preparation, handling, packaging, and shipping protocols is to develop standard procedures which will preserve the integrity of the samples and minimize the potential for sample tracking errors, sample spillage or leakage, and/or sample container breakage. The field team leader is responsible for the implementation of the sample handling, preservation, packaging, and shipping requirements outlined in the project-specific work plan.

1.1 Referenced SOPs

24 – Chain of Custody

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

Required materials may include the following:

- Sample containers (preserved, as necessary, provided by the laboratory)
- Sample bottle labels
- Chain-of-Custody forms
- Sample cooler
- Bubble wrap or other suitable packing material
- “Blue Ice” (*i.e.*, reusable, freezable ice packs) or sealed bagged ice
- Shipping bills (Federal Express, UPS, etc.)
- Field Logbook
- Indelible ink pens
- Packaging tape
- Zip-lock type plastic bags

3.0 METHODOLOGIES

3.1 Sample Handling

Sample Containers

Sample containers and appropriate preservatives (where necessary) will be supplied by the analytical laboratory. After the respective sample containers have been filled with appropriate sample media and preserved as necessary, samples will be properly identified using sample container labels, and the samples will be stored at an appropriate temperature (usually <4°C) to preserve the integrity of the samples.

Sample Preservation

Preservatives will be supplied by the laboratory. When possible, preserved containers should be supplied by the lab. Common preservatives include hydrochloric acid (HCl), sulfuric acid (H₂SO₄), nitric acid (HNO₃), or sodium hydroxide (NaOH). Samples will be preserved in accordance with EPA protocol specified in SW-846 or the project specific protocols outlined in the quality assurance project plan (QAPP). Use of the preservatives will be noted on the COC for each particular sample and analytical parameter.

Sample Labels

Blank sample labels will be supplied by the analytical laboratory and affixed to the sample container. Sample labels will be completed using waterproof permanent markers or ink. The labels will be filled out at the time of sample collection by the field sampling personnel. The following identifying sample information will be included on the label:

- Client/Site
- Sample identification alpha-numeric code defined in the project planning documents
- Sample collector's initials
- Date and time (military) of sample collection
- Analytical method
- Laboratory analysis to be performed

Chain-of-Custody Forms

A chain-of-custody (COC) record will be established and maintained to document sample possession from the time of collection until receipt by the laboratory. A sample is considered to be in custody if it is in your physical possession, if it is in your view after being in possession, or if it is placed in a secure area with access controlled by you. Once samples are received by the laboratory, they will be handled under the laboratory internal COC procedures. Field sampling personnel will initiate a COC record by recording the following minimum data as the samples are collected:

- Client/Site
- Name(s) of sampler(s)
- Sample identification alpha-numeric code
- Date and time (military) of sample collection
- Type of sample (e.g., soil, groundwater)
- Number of containers per sample location
- Requested analyses
- Type of containers and preservatives used
- Name and address for the completed laboratory reports
- Name and address for the laboratory invoices
- Specific instructions/notes for the laboratory, as necessary

Sample COC forms will be placed in waterproof plastic bags and taped to the underside of the cooler lids. Sample COC forms will generally be supplied by the subcontracting analytical laboratory.

Subsequently, at each change of possession, the COC record will be signed by the person relinquishing the samples and by the person receiving the samples. The date and time of the transfer of possession of the sample will be recorded on the COC form; this occurs when the samples are transferred from the sampling personnel to the courier and when the samples are received at the analytical laboratory. Sample COC forms shall be completed in ink. Any transcription errors shall be corrected by striking the erroneous information with a single horizontal line. The correct information will be added immediately adjacent to the strikeout. The sampler should initial the correction. (Refer to *SOP 24 – Chain of Custody* for additional information).

3.2 Sample Packaging and Shipping

All samples will be transported to the analytical laboratory in durable, waterproof, secured metal or plastic coolers. Sample coolers will generally be supplied by the laboratory. All samples will be packaged very carefully to prevent sample breakage. Samples will be shipped *via* overnight carrier (e.g., Federal Express or United Parcel Service) or hand delivered to the analytical laboratory, generally within 48 hours of collection. Airbills serve as custody documentation during shipping. However, project specific protocols will be checked to assure that specified sample holding times are not exceeded in the event that samples are not shipped on the same day that they were collected. Additionally, the sample security and preservation must be maintained if samples are not to be transported immediately to the laboratory. The following procedure should be followed for packaging samples for shipment to the laboratory for testing and/or analysis.

1. Place plastic bubble wrap matting or suitable material over the base and bottom corners of each cooler or shipping container.
2. Obtain a chain-of-custody record (similar to the example shown in Attachment 1 of *SOP 24 – Chain of Custody*) and enter all the appropriate information as discussed above.

Chain-of-custody records will include complete information for each sample. One or more chain-of-custody records shall be completed for each cooler or shipping container as needed to manifest each sample.

3. Place bubble wrapping or other suitable material around glass bottles and place standing upright on the base of the cooler, taking care to leave room for packing material and ice or equivalent. Rubber bands or tape may be used to secure wrapping completely around each sample bottle.
4. Place additional bubble wrap and/or Styrofoam pellet packing or equivalent material throughout the voids between sample containers within each cooler.
5. Place cold packs or ice in heavy duty zip-lock type plastic bags, completely close the bags, and distribute such packages over the top of the samples. Add additional bubble wrap and/or Styrofoam pellets or other packing materials to fill the balance of the cooler or container.
6. If shipping the samples by express, courier, or delivery service, sign the chain-of-custody record thereby relinquishing custody of the samples. The date and time of custody transfer should be recorded on the chain-of-custody form. The custody transfer should be documented when directly transferring custody to a receiving party or when transmitting to a shipping service for subsequent receipt by the analytical laboratory. The shipping service should not be asked to sign chain-of-custody records.
7. Remove the last copy from the chain-of-custody record and retain with the field records. Place the original and remaining copies in a zip-lock type plastic bag and tape the bag to the underside of the lid of the cooler or shipping container.
8. Close the top or lid of the cooler or shipping container and with another person gently rotate the container to verify that the contents are packed so that they do not move. Improve the packaging if needed and reclose.
9. Packaging tape should be wrapped entirely around the sample shipping containers. A minimum of two full wraps of packaging tape will be placed in at least two places on the cooler or shipping container. Some project-specific QAPP may require custody seals be placed on the sample shipping containers. Sign and date the chain-of-custody tape.
- 10a. When transporting samples by automobile to the laboratory, and where periodic changes of ice are required, the cooler should only be temporarily closed so that reopening of the cooler can be easily performed. In these cases, chain-of-custody will be maintained by the person transporting the samples and chain-of-custody tape need not be used. If the cooler is to be left unattended, then chain-of-custody procedures should be implemented.
- 10b. If shipment is required, transport the cooler to an overnight express package terminal or arrange for pickup. Obtain copies of all shipment records as provided by the shipping service.

11. Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the chain-of-custody tape number corresponds with the number on the chain-of-custody record. The analytical laboratory will then forward the back copy of the chain-of-custody record to the sample collector to indicate that sample transmittal is complete.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the samples leaving the site, each sample number and analyses, etc. are to be checked against the project planning documents, sample log sheets/field logbook, and chain of custody forms to ensure that all required samples have been collected and are labeled appropriately, and that bottles are filled for all required analyses.

Quality control samples such as rinsate blanks and duplicates will be specified by the project QAPP. A sample jar containing water should be sent as a temperature blank with each sample shipment requiring temperature preservation to ensure proper temperature is maintained. Also, a trip blank, provided by the laboratory will accompany shipments with samples intended for volatile organic chemical (VOC) analysis.

5.0 DOCUMENTATION AND RECORD KEEPING

The documentation for supporting the sample handling, preservation, packaging and shipping will consist of chain-of-custody records, shipping records and laboratory reports. In addition, a description of sample packaging procedures will be written in the Field Log Book. All documentation will be retained both physically and electronically in the project files.

6.0 REFERENCES

U.S. Environmental Protection Agency, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document: Washington, D.C., OSWER-9950.1.

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods - SW-846 3rd Edition (with revisions): Washington, D.C.

U.S. Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, Part 1: Washington, D.C., EPA/540/P-87/001.

U.S. Environmental Protection Agency, 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA/540/P-91/007.

24 - CHAIN OF CUSTODY

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) presents procedures for documenting possession/custody of environmental samples from the time of collection through delivery to the receiving analytical laboratory. At this point, internal laboratory records should document sample custody until final disposition. This SOP also discusses sample identification and the use of chain-of-custody (COC) forms.

Possession of a sample must be traceable from the time it is collected until analysis is completed. To document sample possession, chain-of-custody procedures are followed. Chain-of-custody evidence includes all documentation associated with the sample including the chain-of-custody form, sample label, custody seal, courier's receipt (if applicable), and field notebook.

A sample is under custody if one or more of the following criteria are met:

- It is in possession of the custodian or a designated member of the sampling team
- It is in plain view, after being in possession
- It was in possession and is secured against tampering
- It is placed in a designated secure area.

1.1 Referenced SOPs

23- Sample Handling, Preservation, Packaging and Shipping

1.2 Definitions

(Reserved)

2.0 REQUIRED MATERIALS

- Sample containers
- Sample container labels
- Chain-of-custody forms
- Zip-lock type plastic bags and tape
- Field logbook and permanent ink, waterproof pen
- Shipping airbills
- Shipping containers
- Locks or packaging tape
- Custody seals.

3.0 METHODOLOGIES

The Project Manager (or designee) is responsible for ensuring that sample labeling is completed in accordance with this SOP and that chain-of-custody forms are completed for sample shipments. All individuals relinquishing and receiving samples shall sign, date, and record the time on the chain-of-custody forms.

3.1 Sample Identification

Blank sample labels will be supplied by the analytical laboratory and affixed to the sample container. Sample labels will be completed using waterproof permanent markers or ink. The labels will be filled out at the time of sample collection by the field sampling personnel. The following identifying sample information will be included on the label:

- Client/Site
- Unique sample identification alpha-numeric code as specified in the Sampling and Analysis Plan
- Sample collector's initials
- Date and time (military) of sample collection
- Analytical method
- Laboratory analysis to be performed

3.2 Chain-of-Custody Forms

Once the sample containers have been filled with the sampled media and properly labeled, they will be prepared for shipment to the receiving analytical laboratory. Coolers containing samples will be accompanied by a chain-of-custody form (see example COC form in Attachment 1).

The field team leader (or designee) shall complete a chain-of-custody form for each lot of packaged samples (*e.g.*, each cooler). COC forms shall be completed in ink. Any transcription errors shall be corrected by striking the erroneous information with a single horizontal line. The corrected information shall be added immediately adjacent to the strikeout. The sampler should initial the correction.

The following information will be recorded on the COC form:

- Client/Site
- Name(s) of sampler(s)
- Sample identification alpha-numeric code
- Date and time (military) of sample collection
- Type of sample (*e.g.*, soil, groundwater)
- Number of containers per sample location
- Requested analyses
- Type of preservatives used

- Name and address for the completed laboratory reports
- Name and address for laboratory invoices
- Specific instructions/notes for the laboratory, as necessary

Any area of the COC, where sample information is not completed should have a diagonal line initialed by the sampler to show that this portion of the COC will not be completed.

Each COC will be placed in a waterproof zip lock plastic bag and affixed to the underside of the shipping container lid. Samples will be packaged properly for shipment as described in *SOP 23 – Sample Handling, Preservation, Packaging and Shipping*, and dispatched to the appropriate laboratory for analysis. Shipping containers will be padlocked or otherwise sealed for shipment to the laboratory, including the placement of custody seals that would indicate a container has been tampered with.

All shipments should be accompanied by the completed Chain-of-Custody Record. The original record will accompany the shipment to the laboratory, and a copy will be retained by the field team leader for the project file. Shipping bills and receipts must be retained as part of the chain-of-custody documentation. These documents should be scanned weekly and will become part of the permanent project files. Paper copies will be maintained in the project files in the office.

Upon receipt of the samples by the laboratory, the laboratory person assigned to log-in samples will confirm that the shipping container seals are in good condition and have not been disturbed. If a disturbance is noted, the laboratory shall notify the Key Project Manager at once. The original chain-of-custody form is to be signed and dated by the laboratory person logging in the samples. In addition, the receiving laboratory is to inspect each sample and indicate the condition of the sample on the COC. The receiving laboratory is to retain a copy of each chain-of-custody form along with the shipping bill. Internal laboratory chain-of-custody procedures will be followed once samples are logged in by the receiving laboratory.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to shipment, the Field Supervisor shall check to ensure that sample numbers are correct, sample paperwork is complete, field logbooks are maintained, and that the Sampling and Analysis Plan has been followed. If a particular sample location is inaccessible or if a sample could not be collected for any reason, the Project Manager is to be notified immediately. Such information must be included in the field logbook.

5.0 DATA RECORDING/MANAGEMENT

All sampling activities are to be documented in the field logbook. As discussed in Section 3.0, information related to tracking environmental samples will be recorded on the COC forms which will be retained in the project files.

All pages of the field logbooks relevant to sampling, as well as copies of all paperwork (COC forms, shipping labels, etc.) are to be scanned. Both paper copies and the digital copies become part of the permanent project file.

6.0 REFERENCES

U.S. Environmental Protection Agency, 1986, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document: Office of Waste Programs Enforcement, Washington, D.C., EPA/530/Sw-86/055.

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 3rd Edition (with revisions): Washington, D.C.

U.S. Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, Part 1: Washington, D.C., EPA/540/P-87/001.

U.S. Environmental Protection Agency, 1991, Compendium of ERT Groundwater Sampling Procedures: Washington, D.C., EPA/540/P-91/007.

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Distribution: Original to Accompany samples; Copy Returned with Report

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Revised 8/13/2012
Exhibit 8

APPENDIX B
LABORATORY QUALITY MANUAL

Cover Page:

Quality Assurance Manual

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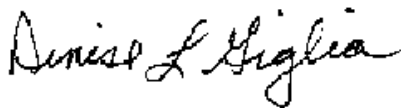
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Organic Preparation Manager – Michelle Freeman

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GC/MS Volatiles Manager – Denise Giglia

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Wet Chemistry Manager – James Rojecki

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GC Semivolatiles / Volatiles Manager – Gary Rudz

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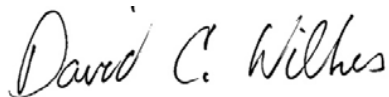
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Metals Manager – Scott Wagner

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Date



GC/MS Semivolatiles / IC Manager – David Wilkes

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Date

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REFERENCED CORPORATE SOPs AND POLICIES

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CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-006	Detection Limits
CA-Q-S-008	Management Systems Review
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CA-L-S-002	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CA-L-P-004	Ethics Policy

CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-007	Controlled Purchases Policy
CW-F-S-018	Vendor Selection
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

SOP Reference	Title
BF-GP-001	Calibration of Autopipettes and Repipetters
BF-GP-002	Support Equipment: Maintenance, Record Keeping and Corrective Actions
BF-GP-005	Sample Homogenization and Subsampling
BF-GP-012	Technical Data Review
BF-GP-013	Manual Integration
BF-GP-015	Record Storage and Retention
BF-GP-018	Strict Internal Chain of Custody
BF-GP-019	Standard Traceability and Preparation
BF-GP-020	Thermometer Calibration
BF-PM-001	Project Information Requirements
BF-PM-003	Bottle Order Set-up
BF-PM-005	Correctness of Analysis
BF-QA-001	Determination of Method Detection Limits
BF-QA-002	Quality Control Limits
BF-QA-003	Procedure for Writing, Reviewing and Revising Controlled Documents

BF-QA-004	Laboratory Personnel Training
BF-QA-005	Preventative and Corrective Action
BF-QA-006	Data Quality Review
BF-SR-001	Cooler Shipping - Bottle Kits and Samples
BF-SR-002	Receipt of Analytical Samples

SECTION 3

INTRODUCTION, SCOPE AND APPLICABILITY

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Buffalo's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards, The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water*, EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water*, Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*, EPA, March 1979.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition September 1986, Final Update I, July 1992, Final Update II A, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261. New York State Analytical Services Protocol, July 2005
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005).
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- APHA, *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 19th, 20th, and on-line Editions. 21st.
- U.S. Department of Energy Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- U.S. Department of Energy Order 414.1C, *Quality Assurance*, June 17, 2005.
- U.S. Department of Energy, *Quality Systems for Analytical Services*, Revision 3.6, November 2010.

- Toxic Substances Control Act (TSCA).

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Section 19.0. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director/Manager and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director/Manager and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. The manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing

regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & updating procedures (refer to BF-QA-003)

SECTION 4

MANAGEMENT REQUIREMENTS

4.1 OVERVIEW

TestAmerica Buffalo is a local operating unit of TestAmerica Laboratories, Inc. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Executive Officer, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Buffalo is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Buffalo laboratory.

4.2.2 Laboratory Director

TestAmerica Buffalo's Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to their respective GM. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program.

The Laboratory Director has the authority to affect those policies and procedures to ensure that only data of the highest level of excellence are produced. As such, the Laboratory Director is responsible for maintaining a working environment which encourages open, constructive problem solving and continuous improvement.

Specific responsibilities include, but are not limited to:

- Provides one or more department managers for the appropriate fields of testing. If the Department Manager is absent for a period of time exceeding 15 consecutive calendar

days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Department Manager to temporarily perform this function. If the absence exceeds 65 consecutive calendar days, the primary NELAC accrediting authority must be notified in writing.

- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensures that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensures TestAmerica's human resource policies are adhered to and maintained.
- Ensures that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory.
- Ensures that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.
- Pursues and maintains appropriate laboratory certification and contract approvals. Supports ISO 17025 requirements.
- Ensures client specific reporting and quality control requirements are met.

Leads the management team, consisting of the QA Manager, the Technical Director, Customer Service Manager, and the Operations Manager as direct reports.

4.2.2 Quality Assurance (QA) Manager or Designee

The QA manager has responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025.

The QA Manager reports directly to the Laboratory Director and has access to Corporate QA for advice and resources. This position is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA department to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.

- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems, data authenticity and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a subset of all final data reports for internal consistency.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Leads the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.

- Evaluation of the thoroughness and effectiveness of training.
- Compliance with ISO 17025.

4.2.3 Technical Director or Designee

The Technical Director reports directly to the Laboratory Director and is responsible for assessing the construction and management of the facility design, maintaining environmental conditions, technical and financial evaluation of capital equipment and capital budgeting and asset valuation.

In addition, the Technical Director solves day to day technical issues, provides technical training and guidance to staff, project managers and clients, investigates technical issues identified by operations personnel or QA, and directs evaluation of new methods. Specific responsibilities include but are not limited to:

- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Compliance with ISO 17025 Standard.

4.2.4 Operations Manager

The Operations Manager reports to the Laboratory Director and oversees the daily operations of the analytical laboratory, maintaining a working environment that encourages open, constructive problem solving and continuous improvement.

The Operations Manager is responsible for supervision of laboratory staff, setting goals and objectives for the laboratory, ensuring compliance with project/client requirements and ensuring on-time performance, supervises maintenance of equipment and scheduling of repairs. Responsibilities also include implementation of the quality system in the laboratory and ensuring timely compliance with audit and QA corrective actions.

In addition, the Operations Manager works with the Technical Director in evaluating technical equipment, assessing capital budget needs and determining the most efficient instrument utilization. More specifically he:

- Evaluates the level of internal/external non-conformances for all departments.
- Continuously evaluates production capacity and improves capacity utilization.
- Continuously evaluates turnaround time and addresses any problems that may hinder meeting the required and committed turnaround time from the various departments.
- Develops and improves the training of all analysts in cooperation with the Technical Director and QA Manager and in compliance with regulatory requirements.
- Works with the Preventive Maintenance Coordinator to ensure that scheduled instrument maintenance is completed.
- Is responsible for efficient utilization of supplies.
- Constantly monitors and modifies the processing of samples through the departments.
- Fully supports the quality system and, if called upon in the absence of the QA Manager, serves as his substitute in the interim.

4.2.5 Department Managers

Department Managers report to the Operations Manager. The Department Managers serve as the technical experts on assigned projects, provide technical liaison, assist in resolving any technical issues within the area of their expertise; and implement established policies and procedures to assist the Operations Manager in achieving section goals. Each one is responsible to:

- Ensure that analysts in their department adhere to applicable SOPs and the QA Manual. They perform frequent SOP and QA Manual review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- With regard to analysts, participates in the selection, training, and development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Human Resources

Departments. They evaluate staffing sufficiency and overtime needs. Training consists of familiarization with SOP, QC, Safety, and computer systems.

- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Director, Operations Manager, and/or QA Manager. Each is responsible for 100% of the data review and documentation, non-conformance and CPAR issues, the timely and accurate completion of performance evaluation samples and MDLs, for his department.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Report all non-conformance conditions to the QA Manager, Technical Director, Operations Manager, and/or Laboratory Director.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintain adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieve optimum turnaround time on analyses and compliance with holding times.
- Conduct efficiency and cost control evaluations on an ongoing basis to determine optimization of labor, supplies, overtime, first-run yield, capacity (designed vs. demonstrated), second- and third-generation production techniques/instruments, and long-term needs for budgetary planning.
- Develop, implement, and enhance calibration programs.
- Provide written responses to external and internal audit issues.

4.2.6 Environmental Health & Safety / Hazardous Waste Coordinator

The Health and Safety Coordinator is responsible for the safety and well-being of all employees while at the laboratory. This includes, but is not limited to, administering the Corporate Safety Manual that complies with federal regulations, MSDS training and review, conducting laboratory safety orientation and tours for all new employees, providing instructions on safety equipment, cleaning up laboratory spills, and instructing personnel of laboratory procedures for emergency situations. The Health and Safety Coordinator is on-call 24-hours a day, 7-days a week for all laboratory situations.

The Health and Safety Coordinator responsibilities additionally include waste management of laboratory generated hazardous waste in accordance with appropriate regulations. This includes maintenance of required documentation, such as waste manifests, segregation of waste in accordance with requirements, and training of personnel in proper segregation of waste and preparation of Safety related SOPs. The EHSC maintains overall EH&S program oversight, but may delegate specific day-to-day activities as necessary.

- Staying current with the hazardous waste regulations.
- Continuing training on hazardous waste issues.
- Reviewing and updating annually the Hazardous Waste Contingency Plan in the Environmental Health & Safety Manual.
- Auditing the staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contacting the hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.
- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene/Safety Manual.
- Administer dispersal of all Material Safety Data Sheet (MSDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairman of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is “reasonable” and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by Test America’s medical consultants.

4.2.7 Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, lab notebooks and/or the Non-Conformance Database.

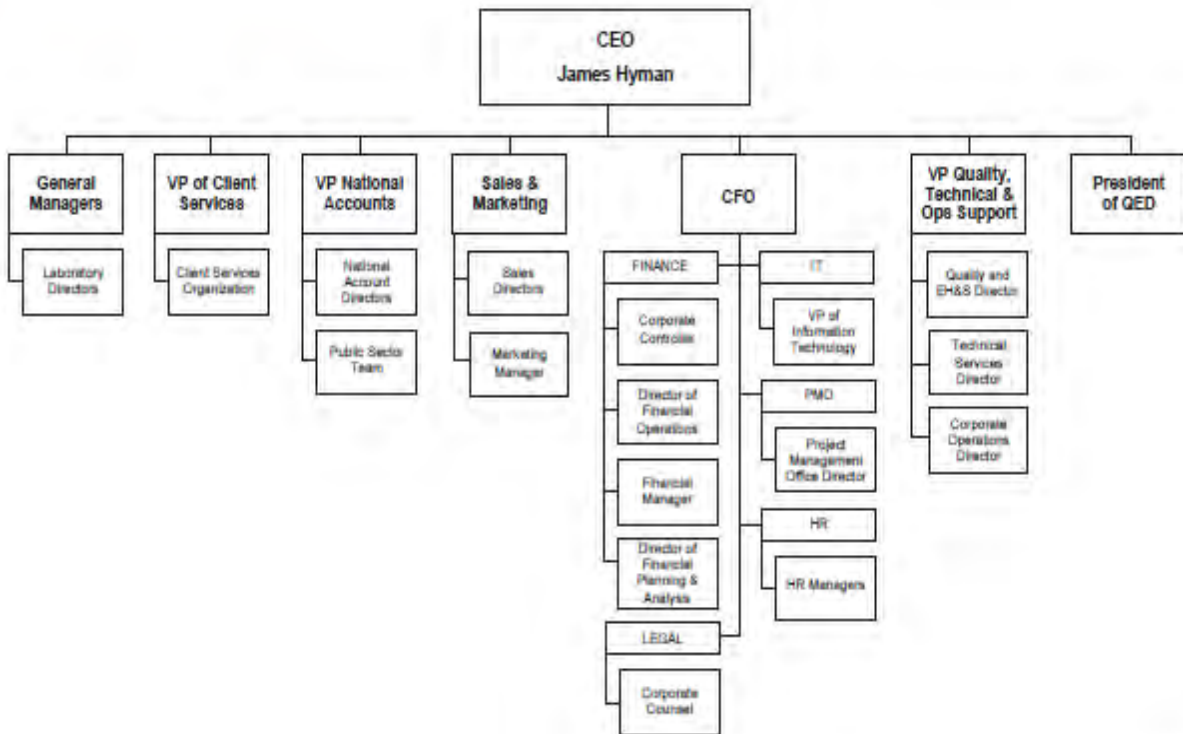
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Director, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.
- Suggest method improvements to their supervisor, the Technical Director, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.

4.3 **DEPUTIES**

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy	Comment
Laboratory Director	Operations Manager (1) Technical Director (2)	
QA Manager	QA Specialist (1) Operations Manager (2)	
Technical Director	Laboratory Director (1) Operations Manager (2)	
Operations Manager	Department Manager (1) Department Manager (2)	Selected based on availability
Customer Service Manager	Project Mng't Manager (1) Laboratory Director (2)	
Project Management Manager	Customer Srv. Manager (1) Project Manager (2)	(2) Selected based on availability
Project Manager	Project Manager (1) Project Management Asst. (2)	(1) 2 ^o team PM (2) Team PMA
Organic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Inorganic Department Manager	Analyst (1) Analyst (2)	Selected based on department, experience and availability
Data Validation / Data Packaging Manager	Data Validation Specialist Data Packaging Specialist	Selected based on department and availability
EHS Coordinator	Safety Officer (1) Sample Mng't Manager (2)	
Sample Management Manager	Sample Custodian (1) EHS Coordinator (2)	
Bottle Preparation / Shipping Manager	Bottle Prep Technician (1) Sample Mng't Manager (2)	

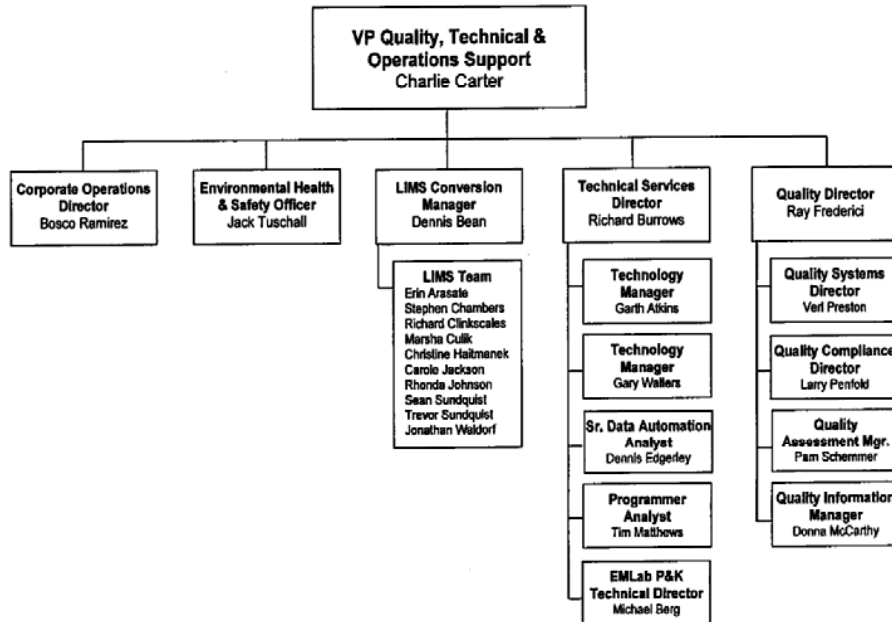
Figure 4-1.
Corporate and Laboratory Organization Charts



Oct 2012



Quality, Technical & Operations Support

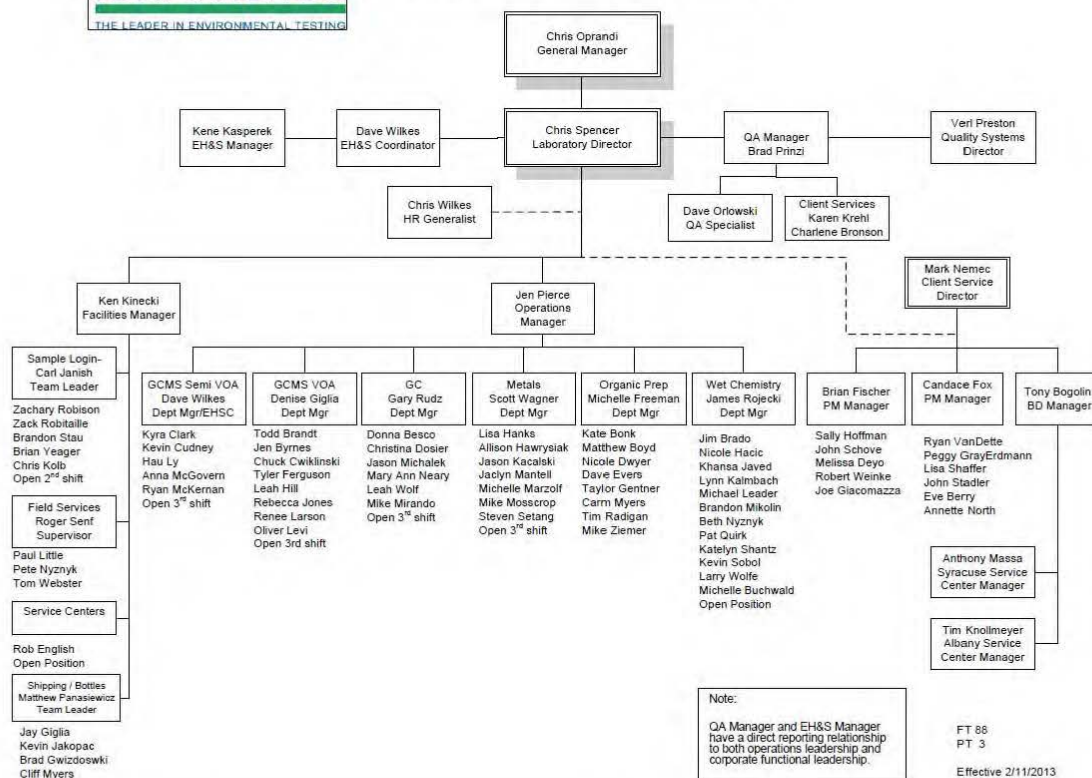


Note:
QA Managers and EH&S Managers have a direct reporting relationship to both operations leadership and corporate functional leadership.

4 Aug 2011



Buffalo Laboratory Organization



SECTION 5

QUALITY SYSTEM

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the NELAC Standards (2003), ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The 7 elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A training program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-L-S-002).

- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents:

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratories normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
-

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

-
- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term "*analytical quality control*". QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains *Quality Control Limit Data in their LIMS system*. A summary report is generated from LIMS to check the precision and accuracy acceptability limits for performed analyses on request. The summary report is generated and is managed by the laboratory's QA department. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits are contained in Section 24.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The procedure for determining the statistical limits may be found in SOP BF-QA-002, Quality Control Limits. The analysts are instructed to use the current limits in the laboratory (dated and approved the QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory through date sensitive tables within the LIMS System. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The QA Manager periodically evaluates these to determine if adjustments need to be made or for corrective actions to methods (SOP No. BF-QA-002). All findings are documented and kept on file.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. BF-QA-003.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action notices. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item, or an 'end of document' page, the effective date, revision number and the laboratory's name. The Quality personnel are responsible for the maintenance of the system.

Controlled documents are authorized by the QA Department and other management. In order to develop a new document, a Department Manager submits an electronic draft to the QA

Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain that document as the official document on file. That document is then provided to all applicable operational units. Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years for the majority of procedures and every 1 year for Drinking Water programs. Changes to documents occur when a procedural change warrants.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual, refer to SOP No. BF-QA-003, "Writing, Reviewing and Revising Controlled Documents". Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. A controlled electronic copy of the current version is maintained on the laboratory Intranet site and is available to all personnel.

For changes to SOPs, refer to SOP No. BF-QA-003, "Writing, Reviewing and Revising Controlled Documents".

Forms, worksheets, work instructions and information are organized by department in the QA office. Electronic versions are kept in a controlled access electronic folder in the QA department. As revisions are required, a new version number and revision date is assigned and the document placed on the laboratory Intranet (BufNet) for use.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. BF-GP-015.

SECTION 7

SERVICE TO THE CLIENT

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the National Account Director, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002, Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Legal & Contracts Director
- General Manager
- Customer Service Manager
- Operations Manager
- Laboratory and/or Corporate Technical Directors
- Corporate Information Technology Managers/Directors
- Regional and/or National Account representatives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The National Account Director, Legal Contracts Director, or local account representative then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Legal & Contracts Director maintains copies of all signed contracts. The Customer Service Manager at the TestAmerica Buffalo facility also maintains copies of these documents.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Regional Account Manager. A copy of the contract and formal quote will be filed with the laboratory PM and the Customer Service Manager.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements. Specific information related to project planning may be found in SOP BF-PM-001, Project Information Requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the management staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation.

Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department Manager.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

Note: ISO/IEC 17025 states that a laboratory "shall afford clients or their representative's cooperation to clarify the client's request". This topic is discussed in Section 7.

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service.

TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8

SUBCONTRACTING OF TESTS

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase “work sharing” refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica’s Corporate SOP’s on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process SOP (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client’s Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client’s analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Customer Service Managers (CSM), or Regional Account Executives (RAE) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies, such as the Department of Energy and the USDA, may require notification prior to placing such work.

Approval may be documented through reference in a quote / contract or e-mail correspondence.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM, Regional Account Executive (RAE) or Customer Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was

designated by the client must be maintained with the project file. This documentation can be

- as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica. A listing of all approved subcontracting laboratories is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab. Verify necessary accreditation, where applicable (e.g. on the subcontractors TNI, A2LA accreditation or State certification).
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- TNI or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work-sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential sub-contract laboratory has not been previously approved, then to begin the process, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site and notify the finance group for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and
- Corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report (Form No. CW-F-WI-009).
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories and Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Laboratory Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM (or RAE or CSM, etc.) responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented on a Subcontract Laboratory Certification Verification Form (Figure 8-1) and the form is retained in the project folder. For TestAmerica laboratories, certifications can be viewed on the company TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples workshared within TestAmerica. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilities successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data are incorporated into the laboratories EDD (i.e. imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. . The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

Figure 8-1 Subcontracting Laboratory Approval Form (Initial / Renewal)

SUBCONTRACTING LABORATORY APPROVAL

Reference: Section 8 – Quality Assurance Manual

Date: _____
Laboratory: _____
Address: _____
Contact and e-mail address: _____
Phone: Direct _____ Fax _____

Requested Item ³	Date Received	Reviewed/ Accepted	Date
1. Copy of State Certification ¹			
2. Insurance Certificate			
3. USDA Soil Permit			
4. Description of Ethics Program ³			
5. QA Manual ³			
6. Most Recent (and relevant) 2 Sets of WP/WS Reports with Corrective Action Response ^{1,3}			
7. State Audit with Corrective Action Response (or NELAC or A2LA Audit) ³			
8. Sample Report ³			
9. SOQ or Summary list of Technical Staff and Qualifications ³			
10. SOPs for Methods to Be Loadshifted ^{2,3}			
11. For DoD Work: Statement that Lab quality system complies with QSM.			
12. For DoD Work: Approved by specific DoD Component laboratory approval process.			

1 - Required when emergency procedures are implemented.

2 - Some labs may not submit copies due to internal policies. In these cases, a copy of the first page and signature page of the SOP is acceptable. This requirement may also be fulfilled by supplying a table of SOPs with effective dates.

3 – If the laboratory has NELAC accreditation, Item #s 4 through 10 are not required.

On Site Audit Planned: YES NO If yes, Date Completed: _____ By Whom: _____

Comments: _____

Lab Acceptable for Subcontracting Work: YES NO Limitations: _____

QA Manager (Signature): _____ Date: _____

☐ Forwarded to Contract Coordinator, by: _____ Date: _____

SECTION 9

PURCHASING SERVICES AND SUPPLIES

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Capital expenditures are made in accordance with TestAmerica's Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007

Contracts will be signed in accordance with TestAmerica's Corporate Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001 and TestAmerica Buffalo SOP on Solvent Purity, SOP BF-OP-013.

9.3.1 Purchasing

Chemical reagents, solvents, glassware and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to

specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. Purchase requisitions are placed into the J.D. Edwards system by designated departmental personnel. The listing of items available in the J.D. Edwards system has been approved for use by the corporate purchasing staff. Each purchase requisition receives final approval by the laboratory Operations Manager or purchasing coordinator before the order is submitted.

The analyst may also check the item out of the on-site consignment system that contains items approved for laboratory use.

9.3.2 Receiving

It is the responsibility of the purchasing coordinator to receive the shipment. It is the responsibility of the department that ordered the materials to date the material when received. Once the ordered reagents or materials are received, the department that submitted the order compares the information on the label or packaging to the original order to ensure that the purchase meets quality level specified. Material Safety Data Sheets (MSDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOP expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date cannot not be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The

comparison studies are maintained along with the calibration raw data for which the reagent was used.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 500 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- umho/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Department Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in the LIMS system, files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Director or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. DOC No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Director and/or the Laboratory Director. If they agree with the request the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, is followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Department Managers, Operations Manager and/or Technical Director.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Finance documents on Vendor Selection (SOP No. CW-F-S-018) and Procurements & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers /vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the

problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form (available on the intranet site).

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10

COMPLAINTS

10.1 OVERVIEW

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, e.g., communications, responsiveness, data, reports, invoicing and other functions expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing with both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following the laboratory SOPs related to Data Quality Review (BF-QA-006) and Corrective Action (BF-QA-005).

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to SOPs BF-QA-006 and BF-QA-005.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likely hood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 13. In addition, Corporate Management, Sales and Marketing and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16)

SECTION 11

CONTROL OF NON-CONFORMING WORK

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory standard procedures, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the department manager for resolution. The department manager may elect to discuss it with the Technical Director, QA Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's job exception and corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Laboratory Director, Technical Director, Operations Manager or QA Manager, documented and included in the project folder. Deviations must also be noted on the final report with a statement that the compound is not reported in compliance with the analytical method requirements and the reason.

11.2 RESPONSIBILITIES AND AUTHORITIES

TestAmerica's Corporate SOP entitled Internal Investigation of Potential Data Discrepancies and Determination for Data Recall (SOP No. CW-L-S-002) outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances the Laboratory Director, the Technical Director, the Operations Manager or the QA Manager may exceptionally authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature

of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's job exception and corrective action procedures described in Section 12. This information may also need to be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility senior laboratory management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, Technical Director, Operations Manager, QA Manager, Customer Service Manager, Human Resources Manager and Business Development Manager. Suspected misrepresentation issues may also be reported to any member of the corporate staff as identified in Ethics Policy, CA-L-P-001. The data integrity hotline (1-800-736-9407) may also be used. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, General Managers and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CW-L-S-002) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system.

On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (i.e., Project Management, Log-in, etc...). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Director, Operations Manager, QA Manager, Department Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Customer Service Manager and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12

CORRECTIVE ACTION

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Report (NCR) also known as Job Exception Reports (JER) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution

12.2.1 Non-Conformance Report (NCR) - (previously known as Job Exception Report and Data Quality Review (DQR)) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Project Management concerns regarding specific analytical results
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the monthly review of JERs.
- Issues found while reviewing JERs that warrant further investigation.
- Questionable trends that are found in the monthly review of DQRs or client complaints

- Internal and External Audit Findings
- Failed or Unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic Reporting / Calculation Errors
- Client complaints
- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. A NCR or CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Department Manager, Operations Manager, Technical Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCR or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Department Manager, Operations Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Department Managers and the Operations Manager are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCR and DQR are entered into a database and each CAR is entered into a spreadsheet for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- The QA Manager reviews monthly NCR and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.
- Also refer to Section 15.1.4, Special Audits)

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of a NCR or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, work instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly at a minimum by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCR and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, not obliterated (e.g. no white-out), and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example – Corrective Action Notice

TestAmerica Buffalo

Corrective Action Summary

T4 Corrective Action Summary

Rev 0

#	Source	Type	Audit Organization	Dept.	Method	Repeat Finding?	Category	Finding, Deficiency, Area Needing Improvement or Recommended Action	Laboratory Investigation Summary	Root Cause of Deficiency	Laboratory Corrective Action Plan	Resp. Person	Date Opened	Response Due	CA Due Date	Date Lab Closed	Follow up notes	28-Jan-13	Follow-up Closed By
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
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Table 12-1.

Example – General Corrective Action Procedures

QC Activity (Individual Responsible for Initiation/Assessment)	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank (Analyst)	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards (Analyst, Department Manager)	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) (Analyst, Department Manager)	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards (Analyst, Data Reviewer)	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) (Analyst, Data Reviewer)	- % Recovery within limits documented in LIMs.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. -For matrix spike or duplicate results outside criteria the data for the data for that sample shall be reported with qualifiers.

QC Activity (Individual Responsible for Initiation/Assessment)	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) (Analyst, Data Reviewer)	- % Recovery within limits specified in LIMS.	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) When the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. Note: If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates (Analyst, Data Reviewer)	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) (Analyst, Data Reviewer)	< Reporting Limit ¹	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples (QA Manager, Department Manager)	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.

QC Activity (Individual Responsible for Initiation/Assessment)	Acceptance Criteria	Recommended Corrective Action
Internal / External Audits (QA Manager, Department Manager, Operations Manager, Technical Director, Laboratory Director)	- Defined in Quality System documentation such as SOPs, QAM, etc.	- Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Department Manager, QA Manager, Corporate QA, Corporate Management)	- SOP CW-L-S-002, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002.
Client Complaints (Project Managers, Lab Director, Sales and Marketing, QA Manager)	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 17 for an example) (QA Manager, Lab Director, Operations Manager, Department Managers)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (EH&S Coordinator, Lab Director, Operations Manager, Department Manager)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through EH&S office.

Note:

1. Except as noted below for certain compounds, the method blank should be below the reporting limit. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the reporting limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and the other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit.

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SECTION 13.0

PREVENTIVE ACTION / IMPROVEMENT

13.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and client satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the monthly QA Metrics Report, evaluation of internal or external audits, results & evaluations of proficiency testing (PT) performance, data analysis & review processing operations, client complaints, staff observation, etc.

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's Corrective Action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.

- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the Annual Management Systems Review (Section 17). A highly detailed report is not required; however a summary of success and failure within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes.

SECTION 14.0

CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued. TestAmerica Buffalo SOP BF-GP-015, Record Storage and Retention specify additional storage, archiving and retention procedures.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Hardcopy technical records are maintained by the Data Deliverables Manager while electronic technical records are maintained by the IT Administrator.

Table 14-1. Record Index¹

	<u>Record Types¹:</u>	<u>Retention Time:</u>
Technical Records	<ul style="list-style-type: none"> - Raw Data - Logbooks² - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports 	5 Years from analytical report issue*
Official Documents	<ul style="list-style-type: none"> - Quality Assurance Manual (QAM) - Work Instructions - Policies - Policy Memorandums - SOPs - Manuals 	5 Years from document retirement date*
QA Records	<ul style="list-style-type: none"> - Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation 	5 Years from archival* <u>Data Investigation:</u> 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)

	Record Types ¹:	Retention Time:
Project Records	<ul style="list-style-type: none"> - Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP -SAP - Telephone Logbooks - Lab Reports 	5 Years from analytical report issue*
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	All HR docs have different retention times: Refer to HR Manual
	Administrative Policies Technical Training Records	7 years

¹ Record Types encompass hardcopy and electronic records.

² Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).

* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss. Retention of records is maintained on-site at the laboratory for at least 3 months after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement. All records shall be protected against fire, theft, loss, environmental deterioration and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to the data is limited to laboratory and company employees and shall be documented with an access log.

Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Whether on-site or off-site storage is used, logs are maintained in each storage box to note removal and return of records. Retention of records are maintained on-site at the laboratory for at least 1 year after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records

related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data. Specific Information related to archival of data for greater than 5 years may be found in TestAmerica Buffalo SOP BF-GP-015.

Table 14-2. Special Record Retention Requirements

Program	¹ Retention Requirement
Drinking Water – All States	5 years (project records) 10 years-Radiochemistry (project records)
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	5 years
NY Potable Water NYCRR Part 55-2	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

¹Note: Extended retention requirements are noted with the archive documents or addressed in TestAmerica Buffalo facility-specific records retention procedure BF-GP-015.

14.1.3 All records are held secure and in confidence. Records maintained at the laboratory are located in the locked on-site storage room. Records archived off-site are stored in a secure location. Access to the off-site storage facility is controlled and logs are maintained for the documented removal/return of records

14.1.4 The laboratory has procedures to protect and back-up records stored electronically

and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. TestAmerica Buffalo SOP BF-GP-015 also contains specific information for archival of scanned data.

14.1.5 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (records stored off site should be accessible within 2 business days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the chain of custody is stored with the project file and the Job Number in TALS. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.
- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.
- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set. Instrument data is stored sequentially by instrument. Calibration data for a given sequence are maintained in the order of the analysis. Sample data are stored on a job number basis in the project file or as part of the daily batch or sequence. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in reconstructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks, bench sheets or excel spreadsheets are used to record and file data. Standard and reagent information is recorded in logbooks or on the raw data for each method as required.
- Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".
- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.
- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned. The procedure for this verification can be found in TestAmerica SOP BF-GP-015.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing of results.

14.2.2 Observations, data and calculations are recorded real-time.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails. The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code;
- Date of analysis; time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a bench sheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in the method specific SOPs, in the instrument method detail records or the instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods, ID codes, volumes, weights, instrument printouts, meter readings, temperatures, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware

audits, backups, and records of any changes to automated data entries.

- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- Procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

14.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

14.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

14.5.3 Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

14.5.4 The laboratory has a record management system (also known as document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per instrument or analysis basis, and are numbered sequentially as they are issued. No instrument or analysis has more than one active notebook at a time, so all data are recorded sequentially within a series of sequential notebooks. Bench sheets and raw data sequence files are filed sequentially by date. Standard and reagent information is maintained in LIMS and logbooks which are maintained on a departmental basis and are numbered sequentially as they are issued or as they are archived by QA.

14.5.5 Records are considered archived when noted as such in the records management system (also known as document control). Access to archived hard-copy information is documented with an access log and in/out records is used to note data that is removed and returned.

14.5.6 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.7 Records Disposal

14.5.7.1 Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program

basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

- 14.5.7.2** Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.
- 14.5.7.3** If a third party records Management Company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15

AUDITS

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee or Corporate QA	All areas of the laboratory annually
Method Audits *	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CA-Q-S-004)	Methods Audits Frequency: 50% of methods annually
Special	QA Department or Designee	Surveillance or spot checks performed as needed to monitor specific issues
Performance Testing	Coordinated by Corporate QA	Two successful per year for each TNI -NELAC field of testing or as dictated by regulatory requirements

* = all methods receive a QA Technical Audit or an SOP Method Compliance Audit annually.

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, NELAC quality systems client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action.

The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, Chrom AuditMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Director or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, Soil, and Air.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. . When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been

affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16

MANAGEMENT REVIEWS

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director for review and comments. The final report shall be submitted to the Operation Manager as well as the appropriate Quality Director and General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Director prepares a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team (Laboratory Director, Technical Director, Operations Manager, Customer Service Manager, and QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-008 & Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective; therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.

- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
 - Adequacy of staff, equipment and facility resources.
 - Adequacy of policies and procedures.
 - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes.

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. The TestAmerica Corporate Data Investigation/ Recall SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's CEO, VP of Quality, Technical & Operations Support, General Managers and Quality Directors receive a monthly report from the Corporate Quality Director summarizing any current data integrity or data recall investigations. The General Manager's are also made aware of progress on these issues for their specific labs.

SECTION 17

PERSONNEL

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staff that possesses a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are

located in the TestAmerica Buffalo Human Resource office (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, pipette, quantitation techniques, etc. are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC)	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Directors/Department Managers – General	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Department Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 **TRAINING**

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 20).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- The Human Resource office maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in TestAmerica Buffalo SOP BF-QA-004, Laboratory Personnel Training.

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive

training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy No. CW-L-P-004 and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 OVERVIEW

TestAmerica Buffalo is a 32,000 ft² secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for field operations, bottle kit preparation, sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. Key equipment has been provided with back-up power supply in the event of a power outage.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Building pass cards and alarm codes are distributed to all facility employees.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. [The reason for this is that it is important to know who is in the building in case of a safety emergency. The visitors logbook is used to ensure that everyone got out of the building safely.] In addition to signing into the

laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed.

Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19.0

TEST METHODS AND METHOD VALIDATION

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 STANDARD OPERATING PROCEDURES (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory:

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP CW-Q-S-002, Writing a Standard Operating Procedure (SOP) and Laboratory SOP BF-QA-003, Procedure for Writing, Reviewing and Revising Controlled Quality Documents (QAM, SOP, etc)
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc.), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

19.4.1.1 The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM); Non-polar Material) by Extraction and Gravimetry, EPA-821-R-98-002, February 1999
- Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.
- Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)
- Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.
- Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.
- Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.

- Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)
- Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994
- NIOSH Manual of Analytical Methods, 4th ed., August 1994.
- Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.
- Standard Methods for the Examination of Water and Wastewater, 18th/19th/20th / on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.
- Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.
- Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.
- National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.
- Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005) (DW labs only)
- Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261
- New York State DEC Analytical Services Protocol, 2005
- New York State DOH Methods Manual

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available

clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

- 19.4.2.1** A demonstration of capability (BF-QA-004) is performed whenever there is a significant change in instrument type (e.g., new instrumentation), method or personnel.
- 19.4.2.2** The initial demonstration of capability must be thoroughly documented and approved by the Operations Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.
- 19.4.2.3** The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Procedures for generation of IDOCs are detailed below and in laboratory SOP BF-QA-004, Laboratory Personnel Training.

- 19.4.3.1** The spiking standard used must be prepared independently from those used in instrument calibration.
- 19.4.3.2** The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

- 19.4.3.3** At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).
- 19.4.3.4** Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.
- 19.4.3.5** When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.
- 19.4.3.6** Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.
- 19.4.3.7** When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:
- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
 - Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 20.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (see Figure 19-1) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to 19.7.10). Generally the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. To allow for some flexibility, this low level standard may be analyzed every batch or every week or some other frequency rather than doing the study all at once. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP No. BF-QA-001 for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

19.8.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

19.8.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation. (For CLP procedures, the IDL is determined using the standard deviation of 7 replicate spike analyses on each of 3 non-consecutive days.)

19.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

19.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, CVAA, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified or see section 20.7.9 for other options. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

19.9.2 When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirement.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory's SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, and specific electrode response factors.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is “a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand” (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result’s validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an “expanded uncertainty”: the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor $k=2$.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent uncertainties at approximately the 99% confidence level with a coverage factor of $k = 3$. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 ± 0.5 mg/L.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g. 524.2, 525, etc) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 SAMPLE REANALYSIS GUIDELINES

Because there is a certain level of uncertainty with any analytical measurement, a sample reparation (where appropriate) and subsequent analysis (hereafter referred to as "reanalysis") may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within ± 1 reporting limit for samples $\leq 5x$ the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.
- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.
- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.
- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Department Supervisor or Laboratory Director/Manager if unsure.

19.14 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the 'TALS Data System' which is a LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes a SQL server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity

Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, and data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.

- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 Ensure Information Availability

Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality

Ensure data confidentiality through physical access controls such as password protection or website access approval, when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The data review sheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

- 19.14.2.1** All raw data must be retained in the project job folder, computer file, and/or run log. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

- 19.14.2.2** In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP.
- 19.14.2.3** In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, final inorganic results are reported to 2 significant figures for values less than 10 and 3 significant figures for values greater than 10 on the final report. Organic results are generally reported to 1 significant figure for values less than 10 and 2 significant figures for values greater than 10 on the final report. The number of significant figures may be adjusted based on client or project requirements.
- 19.14.2.4** For those methods that do not have an instrument printout, an instrumental output or a calculation spreadsheet upload compatible with the LIMS System, the final results and dilution factors are entered directly into LIMS by the analyst, and the software formats the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.
- 19.14.2.5** The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is automatically transferred to the network server and, eventually, to a back-up tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"ed out, signed and dated.
- Worksheets are created with the approval of the Technical Director/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are outlined in several laboratory SOPs (e.g. BF-SR-002, "Receipt of Analytical Samples", BF-GP-012, "Technical Data Review", and BF-PM-001, "Project Information Requirements") to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data (BF-GP-013, Manual Integration). The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 The data review process at the laboratory starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The Project Managers perform review of the chain-of-custody forms and inputted information and approve the input in LIMS to make the samples available to the laboratory departments for batching and processing.

19.14.4.2 The next level of data review occurs with the Analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the LIMS and add any manual data qualifiers or dilution codes if applicable. To ensure data compliance, a different analyst performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Approximately 10% of all sample data from manual methods and from automated methods, all GC/MS spectra and all manual integrations are reviewed. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

- Results deviate from historical trends (if history available)

19.14.4.3 Unacceptable analytical results may require reanalysis of the samples. Any unusual or uncharacteristic circumstances are brought to the attention of the Department Manager. The Department Manager may involve the Project Manager, the Technical Director and/or the QA Manager for further investigation depending on the issue. Corrective action is initiated whenever necessary.

19.14.4.4 The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.

19.14.4.5 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.14.4.6 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report and creates the invoice. When complete, the report is issued to the client.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using SOP CA-Q-S-002 as the guidelines.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

- 19.14.5.3** Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.
- 19.14.5.4** All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1.
Example - Demonstration of Capability Documentation



DOC Cert. Statement
Revision 11
January 23, 2013

TESTAMERICA LABORATORIES, INC.

TRAINING & DEMONSTRATION OF CAPABILITY CERTIFICATION STATEMENT

Employee: _____ Page _____ of _____
Method Number: _____ Date: _____
Parameters or Analytes: _____

Initial Demonstration of Capability: ☐

SOP Number: _____ Revision # _____ Date Read _____

Trained By: _____

Date training began: _____ Date training completed: _____

Continued Demonstration of Capability: ☐

SOP Number: _____ Revision # _____ Date Read _____

I CERTIFY that I have read, understand and agree to use the SOP identified above. I have also submitted data associated with the demonstration of capability.

Employee Signature

Date

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.
2. The test method(s) was performed by the analyst(s) identified on this certification.
3. A copy of the test method(s) and the laboratory-specific Sops are available for all personnel on-site.
4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at this facility, and that the associated information is well organized and available for review by authorized assessors.

Jennifer Pierce
Operations Manager

Signature

Date

Quality Assurance Officer

Signature

Date

SECTION 20

EQUIPMENT (AND CALIBRATIONS)

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory equipment and instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

20.2.1 The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

20.2.2 Routine preventive maintenance procedures and frequency, such as lubrication, cleaning, and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

20.2.3 Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

20.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

20.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

20.2.4.2 Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on 'date' was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrumentation records.

20.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

20.2.5 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses

20.2.6 In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance. Laboratory SOPs BF-GP-001, "Calibration of Autopipettes and Repipetters" and BF-GP-002, "Support Equipment: Maintenance, Record Keeping and Corrective Actions of Analytical Balances, Temperature Control Devices and Reagent Water" provide additional detail on the monitoring and record keeping for support equipment.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All reusable thermometers are calibrated on an annual basis with a NIST-traceable thermometer at temperatures bracketing the range of use. Disposable thermometers are discarded upon expiration and replaced with newly purchased thermometers. IR thermometers should be calibrated over the full range of use, including ambient, iced (4 degrees) and frozen (0 to -5 degrees), per the Drinking Water Manual. The IR thermometers are verified daily and calibrated annually. Digital probes and thermocouples are calibrated quarterly.

The NIST Mercury thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST digital

thermometer is recalibrated every one year (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories) and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the laboratory SOP BF-GP-020, "Thermometer Calibration".

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between $> 0^{\circ}\text{C}$ and $\leq 6^{\circ}\text{C}$.

Specific temperature settings/ranges for other refrigerators, ovens, waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically at a minimum on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.3.6 Field Sampling Devices (Isco Auto Samplers)

Each Auto Sampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is also recorded on the sampling documentation.

The Auto Sampler is calibrated monthly (or if not utilized monthly, immediately prior to its usage) by setting the sample volume to 100ml and recording the volume received. The results are filed in a logbook/binder. The Auto Sampler is programmed to run three (3) cycles and each of the three cycles is measured into a graduated cylinder to verify 100ml are received.

If the RSD (Relative Standard Deviation) between the 3 cycles is greater than 10%, the procedure is repeated and if the result is still greater than 10%, then the Auto Sampler is taken out of service until it is repaired and calibration verification criteria can be met. The results of this check are kept in a logbook/binder.

Additional calibration and use information is detailed in laboratory SOP BF-FS-006, "Calibration of Field Meter".

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

20.4.1.1 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

20.4.1.2 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

20.4.1.3 The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules are methods where the referenced method does not specify two or more standards.

20.4.1.4 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.2 Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and NELAC (2003) standard, Section 5.5.5.10. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met i.e., RPD, per NELAC (2003) Standard, Section 5.5.5.10.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after every 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a).when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b).when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.2.1 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs.) Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.
- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. See laboratory SOP's BF-MB-005 and BF-MV-007 for guidelines for making tentative identifications

Note:

For general reporting if TICs are requested, the ten (10), largest non-target analyte peaks whose area count exceeds 10% of the nearest internal standard will be termed "Tentatively Identified Compounds" (TICs). More or fewer TICs may be identified based on client requirements.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Laboratory Equipment and Instrumentation – TestAmerica Buffalo

Equipment/ Instrument	Manufacturer	Model Number	Serial Number	Year Put into Service	Condition When Received
GC/MS Instrumentation	Agilent	5975	CN10833020	2009	good
GC/MS Instrumentation	Agilent	5975	US80838844	2008	good
GC/MS Instrumentation	Agilent	5973	US44821448	2005	good
GC/MS Instrumentation	Agilent	5973	US52420646	2005	good
GC/MS Instrumentation	Agilent	5973	US41720721	2004	good
GC/MS Instrumentation	Agilent	5973	US35120354	2004	good
GC/MS Instrumentation	Agilent	5973	US41720707	2004	good
GC/MS Instrumentation	Agilent	5973	US10241053	2003	good
GC/MS Instrumentation	Agilent	5973	US30965634	2003	good
GC/MS Instrumentation	Agilent	5973	US03965682	2003	good
GC/MS Instrumentation	Agilent	5973	US05080076	2001	good
GC/MS Instrumentation	Agilent	5973	US05080084	2001	good
GC/MS Instrumentation	Agilent	5973	US03950346	2001	good
GC/MS Instrumentation	Agilent	5973	US82321836	2001	good
GC Instrumentation	Perkin Elmer	Clarus 808 dual uECD	680S10042901	2012	good
GC Instrumentation	Perkin Elmer	Clarus 800 dual FID	665S10020401	2012	good
GC Instrumentation	Agilent	6890 dual uECD	CN10520009	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10520010	2005	good
GC Instrumentation	Agilent	6890 dual uECD	CN10448015	2005	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53126	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A63465	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53464	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53463	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A54409	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A54408	1994	good
GC Instrumentation	Hewlett Packard	5890II FID/FID	3115A34892	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A60622	1994	good
GC Instrumentation	Hewlett Packard	5890II Hal/PID	3235A54089	1994	good
GC Instrumentation	Hewlett Packard	5890II PID/FID	3336A53465	1994	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3336A53727	1994	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3310A47661	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3336A53325	1993	good



GC Instrumentation	Hewlett Packard	5890II PID/FID	3133A37157	1993	good
GC Instrumentation	Hewlett Packard	5890II dual ECD	3203A42206	1992	good
GC Instrumentation	Hewlett Packard	5890II dual FID	3019A28433	1991	good
GC Instrumentation	Hewlett Packard	5890II Hall/PID	3121A35782	1990	good
Metals Instrumentation	Perkin Elmer	Elan 9000 ICP-MS	P0230202	2002	good
Metals Instrumentation	Leeman	PS200 II	HG9045	2000	good
Metals Instrumentation	Leeman	PS200 II	HG0033	2000	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094603	2010	good
Metals Instrumentation	Thermo	ICAP 6000 Duo	ICP-20094602	2010	good
Water Quality Instrumentation	Konelab	Aqua20	SEA032	2009	good
Water Quality Instrumentation	Flash Point Analyzer		Herzog	2007	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	A54TB0578P	2006	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1030	E616130020E	2006	good
Water Quality Instrumentation	Thermo	ECA 1200 TOX	2006.0373	2006	good
Water Quality Instrumentation	Horizon	Speed Vap	03-0415	2005	good
Water Quality Instrumentation	Konelab	20XT	E3719731	2005	good
Water Quality Instrumentation	Thermo	ECA 1200 TOX	2004.901	2004	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	20126	2004	good
Water Quality Instrumentation	Konelab	20	S5019455	2004	good
Water Quality Instrumentation	Glastron	CN Midi-distillation	2502	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2069	2003	good
Water Quality Instrumentation	Glastron	Phenol Midi-distillation	2053	2003	good
Water Quality Instrumentation	Labtronics	BOD Magic - Autoanalyzer	270H3XB531	2004	good
Water Quality Instrumentation	Labtronics	BOD Magic - Autoanalyzer	270J2XB669	2003	good
Water Quality Instrumentation	ManTech	PC Titrator	MS-OK2-607	2003	good
Water Quality Instrumentation	HACH	Spectrophotometer #DR/2500	30200004886	2003	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	2060196	2002	good
Water Quality Instrumentation	Spectronic	Genesis 4001/4	3SGC199091	2000	good

Water Quality Instrumentation	Lachat	Quikchem 8000 Autoanalyzer	A83000-1527	2000	good
Water Quality Instrumentation	OI	Carbon Analyzer Model 1010 #1	H92170411	1999	good
Water Quality Instrumentation	Lachat	Quikchem 8000 Autoanalyzer	A83000-1439	1999	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	99010157	1999	good
Water Quality Instrumentation	Dionex	Ion Chromatograph #DX-120	99110569	1999	good
Water Quality Instrumentation	Orion	Ion Meter #230A	2229	1999	good
Water Quality Instrumentation	VWR	Ion Meter #2100	1083	1997	good
Water Quality Instrumentation	YSI	Oxygen Meter #57	93J09826	1995	good
Water Quality Instrumentation	BOD chamber		Revco	1994	good
Sample Preparation Equipment	TurboVap	II	TV0529N12427	2006	good
Sample Preparation Equipment	TurboVap	II	TV0529N12428	2006	good
Sample Preparation Equipment	J2	ACCUPREP GPC	03F-10723	2003	good
Sample Preparation Equipment	TurboVap	II	TV9445N5816	1996	good
Sample Preparation Equipment	TurboVap	II	TV9427N4133	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5819	1996	good
Sample Preparation Equipment	TurboVap	II	TV944N5820	1996	good
Sample Preparation Equipment	TurboVap	II	TV0024N9623	2000	good
Sample Preparation Equipment	TurboVap	II	TV0022N9604	2000	good
Sample Preparation Equipment	TurboVap	II	TV0312N11592	2003	good
Sample Preparation Equipment	TurboVap	II	TV0312N11591	2003	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16902	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16907	1999	good
Sample Preparation Equipment	Organomation	Rot-X-Tractor	16913	1999	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1847/C5659	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2665/C5674	1994	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2620/C5660	1994	good

Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2245/C6328	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2621/C6733	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2713/C6732	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G1643/C6837	1995	good
Sample Preparation Equipment	Heat Systems	Sonicator #XL-2020	G2742/C6842	1995	good

Table 20-2.

Schedule of Routine Maintenance

Instrument	Procedure	Frequency
Leeman Mercury Analyzer	Check tubing for wear Fill rinse tank with 10% HCl Change dryer tube Fill reductant bottle with 10% Stannous Chloride	Daily Daily As Needed Daily
ICP & ICP/MS	Check pump tubing Check liquid argon supply Check fluid level in waste container Check re-circulator levels Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Change pump oil Change Cones Change printer cartridge Replace pump tubing	Daily Daily Daily Monthly As required Daily Monthly Monthly Monthly As required As required As required
UV-Vis Spectrophotometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Annually
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Oil rollers/chains/side rails Clean optics and cells	Daily Daily Daily Quarterly Weekly Weekly Quarterly
Agilent GC/MS	Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment COMPUTER SYSTEM AND PRINTER: Air filter cleaning Change data system air filter Printer head carriage lubrication Paper sprocket cleaning Drive belt lubrication	Monthly Annually As required As required As required As required As required As required As required As required

Instrument	Procedure	Frequency
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check system for gas leaks with SNOOP Check for loose/frayed power wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	Daily Daily via use of known compound retention Daily As required As required W/cylinder change as required As Required As Required As Required As Required As Required
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
Centrifuge	Check brushes and bearings	Every 6 months or as needed

Table 20-3.

Periodic Calibration

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using "S" NIST traceable weights. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	$\pm 0.2\%$	Clean, check level, insure lack of drafts, and that unit is warmed up, recheck. If fails, call service.
Top Loading Balance	Accuracy determined using "S" NIST traceable. Minimum of 2 standards bracketing the weight of interest. Inspected and calibrated by A2LA accredited person annually.	Daily, when used Annual	$\pm 0.5\%$	Clean. Replace.
NIST Certified Weights	Accuracy determined by accredited weights and measurement laboratory.	1 year	As per certificate.	Replace.
NIST- Traceable Thermometer- Mercury	Accuracy determined by accredited measurement laboratory.	3 years	As per certificate.	Replace.
NIST- Traceable Thermometer- Digital	Accuracy determined by accredited measurement laboratory.	1 year	As per certificate	Replace.
Thermometer	Against NIST-traceable thermometer	Yearly at appropriate temperature range for intended use	$\pm 1.2^{\circ}\text{C}$	Replace
Minimum- Maximum Thermometers	Against NIST-traceable thermometer	Yearly	$\pm 1.5^{\circ}\text{C}$	Replace

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
InfraRed Temperature Guns	Against NIST-traceable thermometer Accuracy determined by accredited measurement laboratory.	Daily at appropriate temperature range for intended use. Annual	$\pm 1.5^{\circ}\text{C}$	Repair/replace
Dial-type Thermometers	Against NIST-traceable thermometer	Quarterly at appropriate temperature range for intended use.	$\pm 1.5^{\circ}\text{C}$	Replace
Refrigerator	Temperature checked using NIST-traceable thermometer.	Daily. If out of range, check again in two hours.	$0-6^{\circ}\text{C}$	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Freezer	Temperature checked using NIST-traceable thermometer	Daily. If out of range, check again in two hours.	$(-10)-(-20)^{\circ}\text{C}$	Adjust. Repair. While waiting for repair, seal door, attach "Out of Service" sign, move items to functional unit. Notify supervisor.
Oven	Temperature checked using NIST-traceable thermometer.	When in use.	$104 \pm 1^{\circ}\text{C}$ (drying) $180 \pm 2^{\circ}\text{C}$ (TDS)	Adjust. Replace.
Water Bath	Temperature checked using NIST-traceable thermometer.	When in use.	$\pm 2^{\circ}\text{C}$	Adjust. Replace.
Volumetric Dispensing Devices (Eppendorf ® pipette, automatic dilutor or dispensing devices)	One delivery by weight. Using DI water or solvent of use, dispense into tared vessel. Record weight with device ID number. Calibrate using 4 replicate gravimetric measurements	Each day of use Quarterly	$\pm 2\%$ Calculate accuracy by dividing weight by stated volume times 100 for percent.	Adjust. Replace.

Instrument	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Glass Microliter Syringes	None	Accuracy must be initially demonstrated if syringe was not received with a certificate attesting to established accuracy.	$\pm 1\%$	Not applicable.
Deionized Water	Check in-line conductivity meter on system with conductivity meter in Inorganics Department.	Daily	$<1.0 \mu\text{mho}$ at 25°C	Record on log. Report discrepancies to QA Manager, Operations Manager or Technical Director.

SECTION 21

MEASUREMENT TRACEABILITY

21.1 OVERVIEW

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g. bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory accreditation Cooperation) or APLAC (Asia – Pacific Laboratory Accreditation Cooperation)..A certificate and scope of accreditation is kept on file at the laboratory.

The calibration report or certificate submitted to **TestAmerica Buffalo** contains, in a well designed format, a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. Opinions and interpretations of results are presented along with the basis upon which they were made and identified as such. The report may be submitted by facsimile or other electronic means as long as the requirements of the International Standard are achieved. If significant amendments are made to a calibration certificate, a supplemental certificate for the serial-number-specified piece of equipment is so identified. When a new certificate is offered, it uniquely identifies and references the one it replaces. All calibration reports are filed in the QA Office.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by A2LA or NVLAP with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. Method specific information may also be found in the laboratory method SOPs in the "Standards and Reagents" sections. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and

acids are tested for acceptability prior to company wide purchase. Refer to SOP No. CA-Q-S-001, Solvent and Acid Lot Testing and Approval.

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained by each department in bound or electronic folders. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer laboratory SOP BF-GP-019, "Standard Traceability and Preparation" and also to the method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory department's chemical history log and are assigned a unique identification number. Preparation of working standards or reagents prepared from the stock is documented in the laboratory Department's Standard Preparation Log. The following information is typically recorded:

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment section

Records are maintained for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date
- Standard ID from LIMS.
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained ***in the LIMS system.***

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOPs.

SECTION 22.0

SAMPLING

22.1 OVERVIEW

The laboratory provides sampling services. Sampling procedures are described in the following SOPs:

BF-FS-001	Chain of Custody Documentation
BF-FS-002	Sample Packaging and Shipment Off-Site
BF-FS-003	Groundwater Sampling Field Data Collection
BF-FS-004	Equipment Decontamination
BF-FS-005	Groundwater/Surface Water Sampling
BF-FS-006	Calibration of Field Meter
BF-FS-007	Low Flow Sampling Procedures
BF-FS-008	Surface and Subsurface Soil/Sediment Sampling

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the chain-of-custody (COC) form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g. 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g. 6 hours, 24 hours, etc.) are measured from date and time zero. The

first day of holding time for time critical parameters ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis. However there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is. These programs will be addressed on a case-by-case basis.

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the following tables are derived from the source documents for the methods. If method required holding times, this info is in the SOP or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

The following information provides general guidance for homogenization and subsampling. For laboratory specific procedures refer to SOP BF-GP-005, "Sample Homogenization and Subsampling".

SECTION 23

HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The shipping documents are retained with the project files.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC or in the project notes, sample management will initiate Strict Chain of Custody procedures as defined in SOP BF-GP-018, "Strict Internal Chain-of-Custody".

23.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

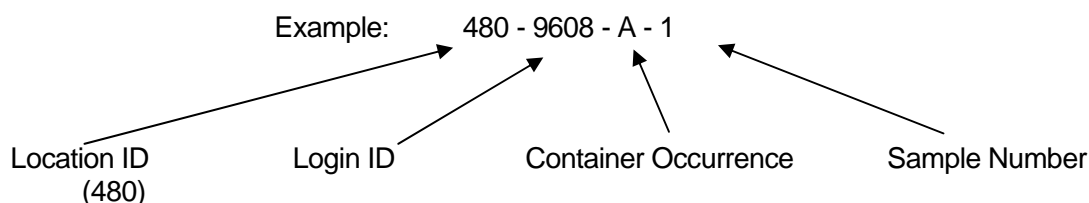
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on the Sample Login Form – and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Buffalo Laboratory (Location 480). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: XXX - 9608 - A - 1 - A ← Secondary Container Occurrence

Example: 220-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;

- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);
- The project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks described in Section 23.1.1.1 that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. BF-SR-002.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Aqueous samples designated for metals analysis are stored at ambient temperature. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed at a minimum of every two weeks.

Analysts and technicians provide a request form to the cooler custodian who then retrieves the requested samples. In the absence of the cooler custodian, the analysts may personally retrieve the sample containers allocated to their analysis from the designated refrigerator. The samples are placed on carts, transported the analytical area and analyzed. Following analysis the remaining sample is returned to the refrigerator from which it originally came. All unused portions of samples are returned to the secure sample control area. All samples are kept in the refrigerators for two to four weeks after analysis, which meets or exceeds most sample holding

times. After two to four weeks the samples are moved to dry room temperature, sample archive area where they are retained a minimum of 2 weeks after the final report has been issued to the client at which time disposal occurs. Special arrangements may be made to store samples for longer periods of time. Extended archival periods allow additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

To minimize exposure to personnel and to avoid potential accidents, samples which are known or suspected to be hazardous are segregated and a notification is issued to all laboratory personnel.

All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm. All soil samples, including foreign soil samples are heat treated or incinerated in accordance with USDA permit requirements and are transported / disposed by USEPA approved facilities.

Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). For sample shipments which include water/solid volatile organic analyses (see Note), a trip blank is enclosed when required by method specifications or state or regulatory programs. The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will analyze the trip blanks that were supplied.

23.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: BF-WM-001, "Waste Management".) All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than six weeks from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample may request to participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal and nature of disposal (such as sample depletion, hazardous waste facility disposal, and return to client). All disposal of sample containers is accomplished through incineration. A Waste Disposal Record should be completed.

Figure 23-2.

Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

- 1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
 - *Client name, address, phone number and fax number (if available)*
 - *Project name and/or number*
 - *The sample identification*
 - *Date, time and location of sampling*
 - *The collectors name*
 - *The matrix description*
 - *The container description*
 - *The total number of each type of container*
 - *Preservatives used*
 - *Analysis requested*
 - *Requested turnaround time (TAT)*
 - *Any special instructions*
 - *Purchase Order number or billing information (e.g. quote number) if available*
 - *The date and time that each person received or relinquished the sample(s), including their signed name.*
 - ***The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.***
 - **Information must be legible**
- 2) Samples must be properly labeled.
 - Use durable labels (labels provided by TestAmerica are preferred)
 - Include a unique identification number
 - Include sampling date and time & sampler ID
 - Include preservative used.
 - Use indelible ink
 - **Information must be legible**
- 3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested.
- 4) Samples must be preserved according to the requirements of the requested analytical method. See lab Sampling Guide.

Note: Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.
- For Volatile Organic analyses in drinking water (Method 524.2). Residual chlorine must be neutralized prior to preservation. If there is prior knowledge that the samples are not chlorinated, state it on the COC and use the VOA vials pre-preserved with HCl. The following are other options for a sampler and laboratory where the presence of chlorine is not known:
 - 1. Test for residual chlorine in the field prior to sampling.
 - If no chlorine is present, the samples are to be preserved using HCl as usual.
 - If chlorine is present, add either ascorbic acid or sodium thiosulfate prior to adding HCl.
 - 2. Use VOA vials pre-preserved with sodium thiosulfate or ascorbic acid and add HCl after filling the VOA vial with the sample.
- **FOR WATER SAMPLES TESTED FOR CYANIDE – for NPDES samples by Standard Methods or EPA 335**
 - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.
 - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.
 - It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.
 - The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

5) Sample Holding Times

- TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (2 working days) remaining on the holding time to ensure analysis.
- Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis.

- 6) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply this blank with the bottle order.
- 7) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.
- 8) Recommendations for packing samples for shipment.
 - Pack samples in Ice rather than “Blue” ice packs.
 - Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.
 - Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.
 - Fill extra cooler space with bubble wrap.

Figure 23-3.

Example: Cooler Receipt Form

Doc. Login Front

TestAmerica Buffalo

Doc. LoginFront
Rev 13
09/21/2012

LOGIN	Copy from
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Company _____ Project # _____

Event _____ Analysis _____

TAT _____ BD/ _____ CD _____ # OF SAMPLES _____ TRIP BLANK Y/N # _____

SHIPPED BY	ATTACH SHIPPING TAGS(back)
RECEIVED DATE / TIME:	____ / ____ / ____ : ____

COOLER(s) _____ Temps _____ °C (<6 °C)
IR GUN 1 2 3

CUSTODY SEAL INTACT? YES/NO NONE RAD CHECK <0.02mR/hr: Y/N

RESIDUAL CHLORINE CHECK

☐ YES, OK ☐ YES, Qualified ☐ YES, Preserved ☐ NO, lab to check ☐ N/A

WORKSHARE/SUB Y/N LAB _____ ICOC # _____

RECEIVED OUTSIDE HOLD TIME Y/N _____

CHECKLIST ISSUES Y/N _____

PRESERVATION CHECKED YES _____ NO _____ NA _____ Initials _____

ARE SAMPLE DATES AND TIMES CORRECT? Initials _____

WERE ALL THE APPROPRIATE TESTS ASSIGNED? Initials _____

NCM _____ COC SCANNED Y/N _____

ANALYSIS GROUP ISSUES _____

Temp Cert Loss:

Company Confidential & Proprietary

Section 24.0

ASSURING THE QUALITY OF TEST RESULTS

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 NEGATIVE CONTROLS

Table 24-1.

Control Type	Details
Method Blank (MB)	Are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples.
	The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	Are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1.

Control Type	Details
Instrument Blanks	Are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank ¹	Are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan) Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks ¹	Are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks ¹	Are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

¹ When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

- 24.4.1.1** The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.
- 24.4.1.2** The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard may be reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.
- 24.4.1.3** Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).
- 24.4.1.4** The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.
- 24.4.1.5** If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.
- 24.4.1.5.1** For methods that have 1-10 target analytes, spike all components.
- 24.4.1.5.2** For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- 24.4.1.5.3** For methods with more than 20 target analytes, spike at least 16 components.
- 24.4.1.5.4** Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

24.4.1.5.5 Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 SAMPLE MATRIX CONTROLS

Table 24-5. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency ¹	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	Essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency ¹	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates ²	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency ¹	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency ¹	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

¹ See the specific analytical SOP for type and frequency of sample matrix control samples.

² LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

24.6.1 As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where

there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

24.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

24.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

24.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

24.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

24.6.3.3 The lowest acceptable recovery limit will be 10% (the analyte must be detectable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable.

24.6.3.4 The maximum acceptable recovery limit will be 150%.

24.6.3.5 The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.

24.6.3.6 If either the high or low end of the control limit changes by $\leq 5\%$ from previous, the data points are inspected and, using professional judgment, the limits may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

24.6.4.1 The control limits are maintained in the laboratory LIMs system. The limits for each analyte/method/matrix combination are assigned effective and expiration dates. The QA department is able to query the LIMs system and print an active list of control limits based on

this database. The most current laboratory limits (based on the effective/expiration dates) are reflected on the laboratory worksheets and final reports unless superseded by project specific limits.

24.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 13) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

24.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

24.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

24.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

24.7.1 The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples.

24.7.2 A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

24.7.3 Use of formulae to reduce data is discussed in the method SOPs and in Section 20.

24.7.4 Selection of appropriate reagents and standards is included in Section 9 and 22.

24.7.5 A discussion on selectivity of the test is included in Section 5.

24.7.6 Constant and consistent test conditions are discussed in Section 19.

24.7.7 The laboratories sample acceptance policy is included in Section 23.

SECTION 25.0

REPORTING RESULTS

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. A variety of report formats are available to meet specific needs. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report) with a "sample results" column header.

25.2.2 Each report cover page is printed on company letterhead which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. job number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as # / ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.
- In most cases, the applicable COC is paginated and is an integral part of the report.

- Any additional addenda to the report must be treated in a similar fashion so it is a recognizable part of the report and cannot accidentally get separated from the report (e.g. Sampling information).

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Practical quantitation limits or client reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits (if requested).

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda). Sample temperatures are recorded in the report case narrative and on the COC. Deviations from normal conditions (e.g., preservation, breakage) are recorded in the report case narrative.

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.19 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.20 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not.

25.2.21 The laboratory includes a cover letter.

25.2.22 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.23 When Soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.

25.2.24 Appropriate laboratory certification number for the state of origin of the sample if applicable.

25.2.25 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g, partial report). A complete report must be sent once all of the work has been completed.

25.2.26 Any non-TestAmerica subcontracted analysis results are provided as an addendum to the report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica Buffalo offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including results for the method blank, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. All faxed reports are followed by hardcopy. Procedures used to ensure client confidentiality are outlined in Section 26.7.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. **TestAmerica Buffalo** offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report

25.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

25.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

25.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

25.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This

necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in Section 8.

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. It is our policy that facsimiles are intended for and should be used for business purposes only. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender.

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "R". The revised report will have the word "revised" appended to the cover letter.

When the report is re-issued, a notation of "revised" is placed on the cover/signature page of the report. A brief explanation of reason for the re-issue is included in the report case narrative.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

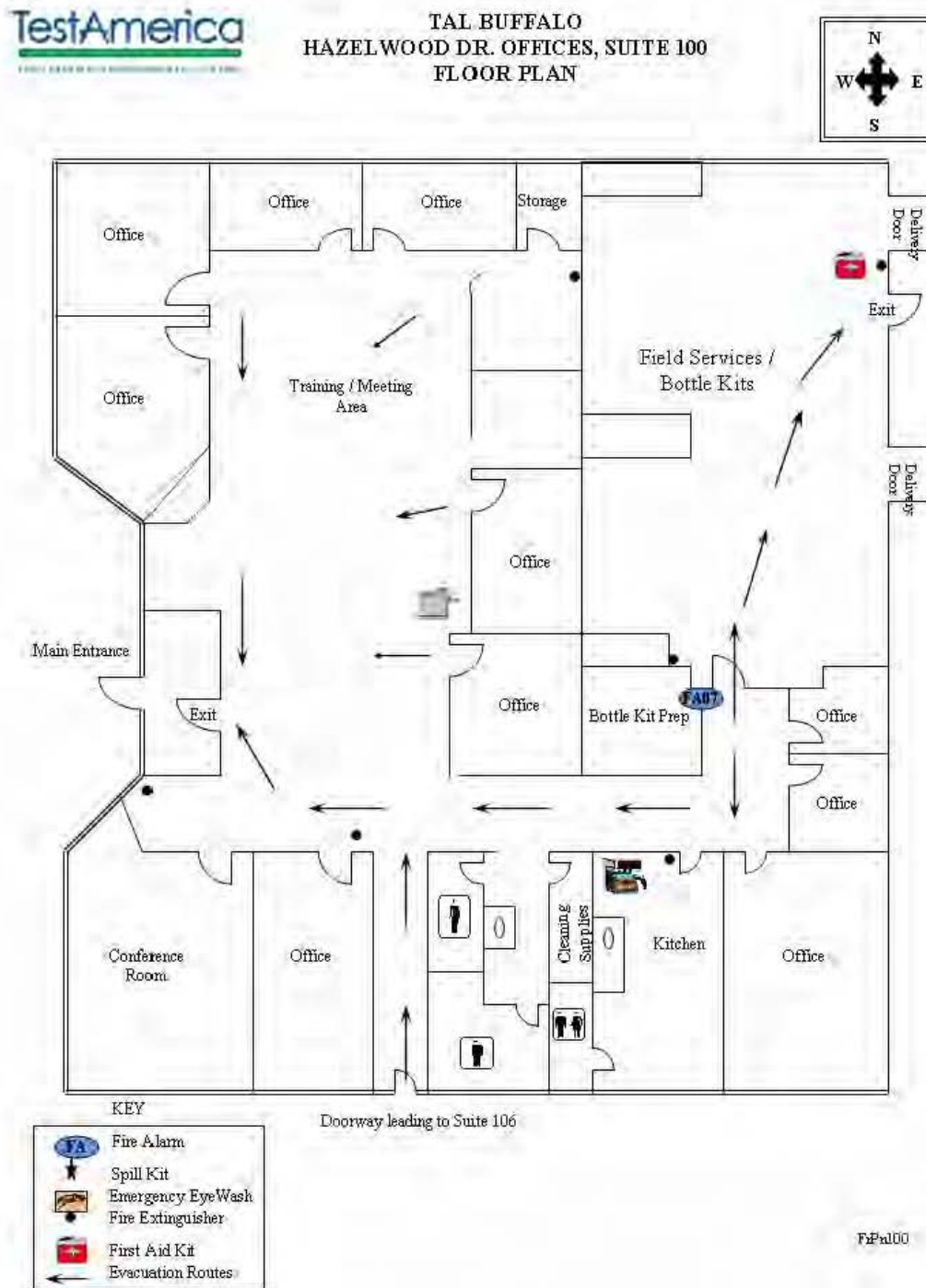
Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely no possible impact on the interpretation of the analytical results and there is no possibility of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

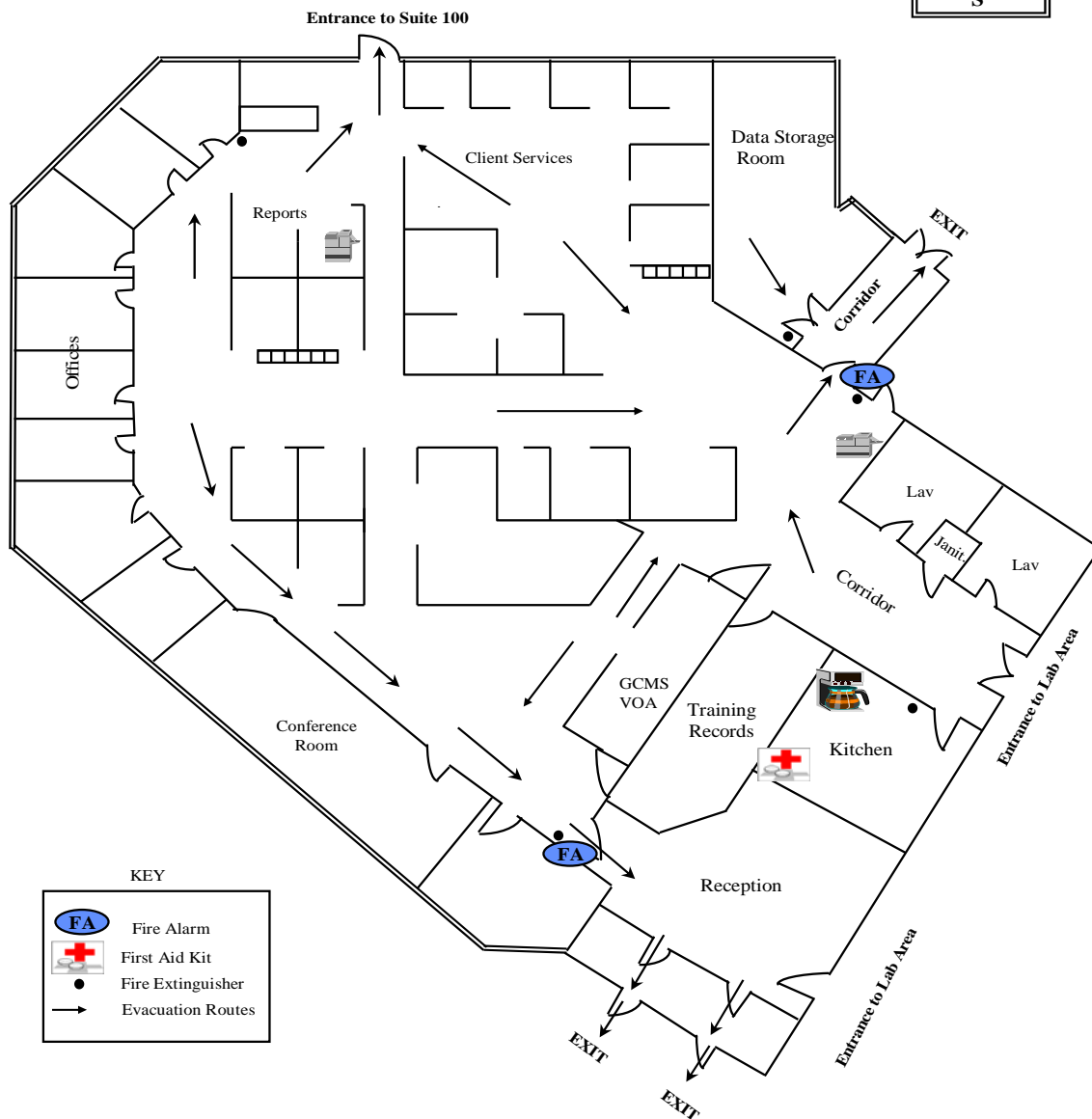
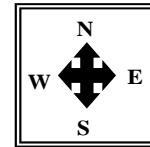
Appendix 1.



Company Confidential & Proprietary



**TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 106
CLIENT SERVICES/REPORT PREP
FLOOR PLAN**



FrP1106L
3/2005



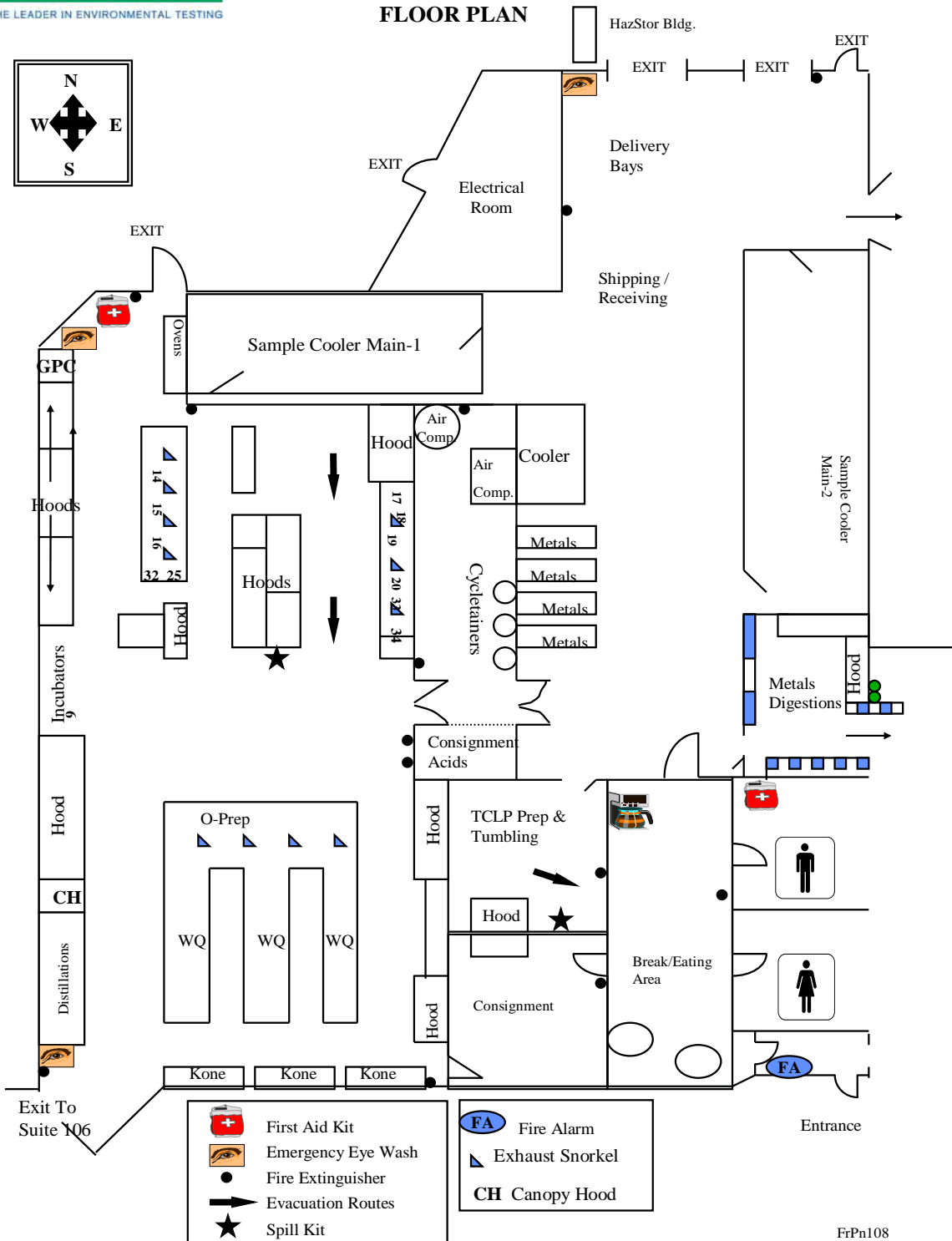
**TAL BUFFALO
HAZELWOOD DR. NY OFFICES, SUITE 106
LABORATORY AREA
FLOOR PLAN**



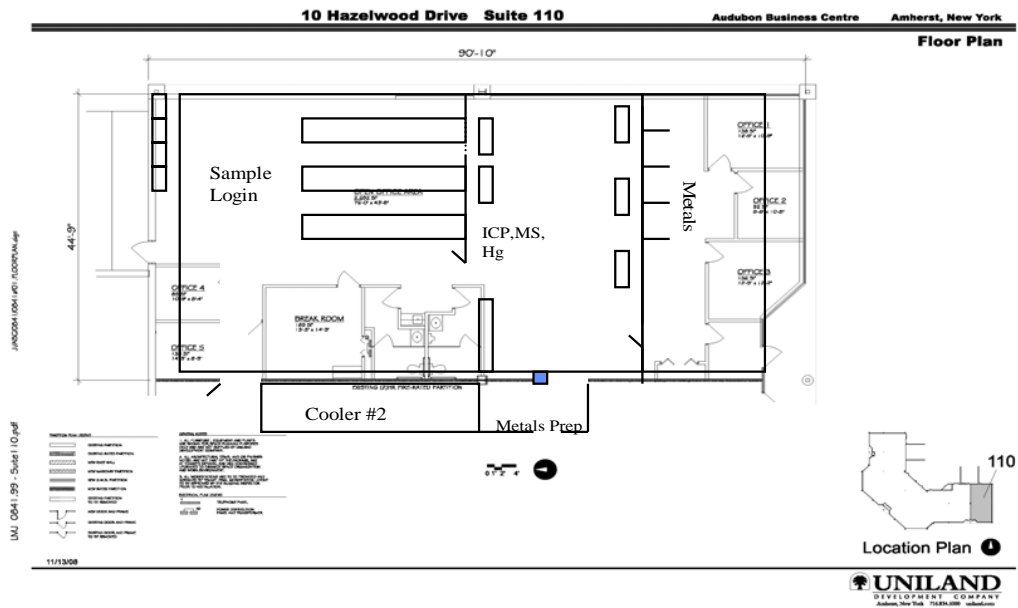
FrPn106r
03/2005



TAL BUFFALO
HAZELWOOD DR. OFFICES, SUITE 108
FLOOR PLAN



FrPn108
 03/2005



Appendix 2. Glossary/Acronyms

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (TNI)

Accrediting Authority: The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (TNI)

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (TNI)

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the

usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI).

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (TNI)

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength

Derivatization
Mass spectral interpretation
Alternative detectors or
Additional Cleanup procedures

(TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (TNI)

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (TNI)

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is $\pm 100\%$. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for Inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% Settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% Settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (NELAC)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (TNI)

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (TNI)

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (TNI)

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (TNI)

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (NELAC)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI) [2.1]

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are

used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of NELAC standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or and which is accepted as the method for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS-ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
NELAC – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3.

Laboratory Certifications, Accreditations, Validations

TestAmerica Buffalo maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

State	Program	Cert # / Lab ID
Arkansas	CWA, RCRA, SOIL	88-0686
California*	NELAP CWA, RCRA	01169CA
Connecticut	SDWA, CWA, RCRA, SOIL	PH-0568
Florida*	NELAP CWA, RCRA	E87672
Georgia*	SDWA, NELAP CWA, RCRA	956
Illinois*	NELAP SDWA, CWA, RCRA	200003
Iowa	SW/CS	374
Kansas*	NELAP SDWA, CWA, RCRA	E-10187
Kentucky	SDWA	90029
Kentucky UST	UST	30
Louisiana*	NELAP CWA, RCRA	2031
Maine	SDWA, CWA	NY0044
Maryland	SDWA	294
Massachusetts	SDWA, CWA	M-NY044
Michigan	SDWA	9937
Minnesota	SDWA, CWA, RCRA	036-999-337
New Hampshire Primary*	NELAP SDWA, CWA, RCRA	2973
New Hampshire Secondary*	NELAP SDWA, CWA, RCRA	2337
New Jersey*	NELAP, SDWA, CWA, RCRA,	NY455
New York*	NELAP, AIR, SDWA, CWA, RCRA	10026
North Dakota	CWA, RCRA	R-176
Oklahoma	CWA, RCRA	9421
Oregon*	CWA, RCRA	NY200003
Pennsylvania*	NELAP CWA, RCRA	68-00281
Rhode Island	SDWA, CWA	LAO00328
Tennessee	SDWA	02970
Texas*	NELAP CWA, RCRA	T104704412-08-TX
USDA	FOREIGN SOIL PERMIT	S-41579
Virginia	SDWA	278
Washington*	NELAP CWA, RCRA	C1677
Wisconsin	CWA, RCRA	998310390
West Virginia	CWA, RCRA	252

The certificates and parameter lists (which may differ) for each organization may be found on the corporate web site, the laboratory's public server, and in the QA Department.